Pit and Quarry

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Pit and Quarry

Vol. 14 CHICAGO, ILL., MAY 25, 1927 No. 4

LIME MANUFACTURERS PAUSE TO CONSIDER PRESENT AND FUTURE OF INDUSTRY

By H. W. Munday

WHITE SULPHUR SPRINGS, West Virginia, was the scene of the Ninth Annual Convention of the National Lime Association on May 17, 18 and 19. This convention was radically different from those of the past several years. There were no technical sessions or papers. The discussions and sessions were participated in by only actual lime manufacturers. Only problems of actual sales promotion and selling were considered on the program. The attendance was disappointing, particularly as all lime manufacturers whether members of the National Lime Association or not were invited to be present. Less than one hundred attended. Those in attendance were most concerned with determining the actual conditions of the lime industry as they exist that they might guard against every adverse factor.

The Board of Directors of the National Lime Association had decided shortly before the convention to curtail the work of the national organization to the extent of reducing the staff to a general manager and the minimum of clerical help. This action was taken in anticipation that a complete retrenchment policy would be adopted at this convention. A new plan of operation was proposed for consideration. Reluctantly but with good business reason the convention approved the action of the directors and decided to reduce the dues to one cent per ton and cut the national organization down to only a general manager and the necessary clerical help. District groups are to be formed and will handle their own special problems of research and promotion. It was in anticipation of such action that the program of the convention was arranged as it was. Even after sound judgment had been passed upon some problems the convention could not seem to act. They seemed to be floundering in the dark. Next year will be a crucial one for the industry. There will not be a president but an executive committee consisting of three divisional presidents will handle the affairs of the national association. G. B. Arthur will continue as general manager.

Mr. Charles Warner, president of the National Lime Association, called the convention to order on Tuesday morning and opened the session with his address. Mr. Warner reviewed the events leading up to the decision of the board of directors to curtail the expenses and work of the National Association staff. The problem facing the convention was outlined by Mr. Warner in the following remarks:

"We propose to concentrate exclusively our national sales methods on sales promotion policies, believing this to be the outstanding need of our industry at this time. This convention is broader because we decided to invite all manufacturers of lime products, regardless of membership, to join with us in discussing the outstanding needs of the industry.

"While many have believed that the working policy of the National Association in its effort to function broadly in behalf of the lime manufacturers has been based on sound lines, yet it has been apparent at times that the association has lost some ground in maintaining the moral and financial support of a sufficient number of manufacturers to make its policies effective. The more nearly an association represents 100 per cent of the manufacturers of the industry, the better it can serve the industry in the performance of those duties belonging to an associated effort. With a little less than 50 per cent of the productive capacity of the industry represented in our membership, it goes without saying that the possible effectiveness of our work has been seriously curtailed. I feel that so far as funds have permitted, and so far as thought and planning by your organization and your board of directors are concerned, the work has been well done.

"It is natural from the character of our industry that there should be 57 varieties of views as to proper methods of carrying on associated work, due to the 157 varieties of limes and sales problems. It is a fundamental difficulty of our industry that our products are manufactured directly from raw materials having diverse characteristics without much opportunity to change these characteristics during the process of manufacture.

"The lime industry is not the only industry in this country that is facing a particularly hard and trying problem with a steady downward trend in its prices. There is a general downward trend in all commodity prices, but the rate at which this trend progresses and its possible interruption for shorter or longer periods are largely dependent upon the relation between consumption and production in each industry. As an industry, we have an entirely legal method of staying this trend by energetic field promotion of new uses and an enlargement of old uses of our product. We have full legal and moral rights to exercise collective effort in this character of promotion work, and unless it is done with great force, we can erpect the general downward trend in commodity prices to continue to affect lime prices. This downward trend in commodity prices has amounted to over 10 per cent in the last 15 months and while the situation has varied in many lime districts, and in the various grades of lime, I should imagine that the average price trend in lime products during these same 15 months has not been far off from the average general drop of 10 per cent."

G. B. Arthur, general manager of the association, presented his annual report. The present status of the membership and finances were reported in detail. A chart was presented showing the necessary adjustments in organization covering three plans for dues involving one, two and three cents per ton. With the dues plan of one cent per ton all research and field work was eliminated, leaving only a general manager, clerical help and an office. The stock of various bulletins on hand was given and the association patents listed in detail. Mr. Arthur presented some significant facts in the course of his report and a few of these will be stated here.

"The membership reported 1,811,303 tons as their average production for 1923-24. The average census reports for these years allow 4,074,121 tons for the industry, which means 2,262,818 tons outside of the association. The average tonnage for members is 26,638 tons while the average for the non-members is 13,882 tons. In 1924, agriculture consumed about 245,000 tons, industries 1,880,000 and construction 2,149,121 tons. The increase for construction in 1926 was expected to be even greater, with a slight gain for industrial uses and no gain and possibility for agriculture. More than half of the money used in construction last year went into the small house classification.

"The American Society for Testing Materials has approved the specifications for lime stucco, plaster, and plastering sand which were prepared with the help of the Bureau of Standards, the American Institute of Architects, the Union Plasterers of Chicago and the Contracting Plasterers of Chicago. One of the notable events of the year as a change of the Portland Cement Association from high percentages of cement in mortar to the 50-50 mixture. If any mixture is desired in concrete it should be hydrated lime. Through work with the technical men of the Common Brick Manufacturers' Association, they are about to recommend straight lime mortars where the loads do not exceed 100 pounds per square inch, and 50-50 mortar elsewhere. Work has been done on building codes in Kansas City, Chicago, Cincinnati, St. Louis, Philadelphia, and with the Pacific Coast Building Officials' Conference.

"Three years ago new tonnage was predicted in connection with petroleum refining, based upon the success of the Zalondek process. While that process has not become successful, it turned the attention of refining men to lime for stopping corrosion. Today every big operation is experimenting with lime for one purpose or another. Corrosion alone requires a half pound of lime for a barrel of oil, with an output for the oil industry of two million barrels daily."

Can Promotion and Selling Be Done by Same Man?

By C. C. Schmoeller

The idea most of us have in mind when speaking of promoting lime is to create a demand for lime that did not previously exist or to reinstate the use of lime where it has been supplanted by a substitute material. By selling lime, when used in the term "Promotion and Selling" we do not mean the sale of lime in existing channels. What we do mean is the sale of lime into channels created by the previous act of promoting. It is this we have in mind when we ask "Can promoting and selling be done by the same man?" Manifestly, the use of lime is not promoted unless the lime is sold and used. As members of the National Lime Association we are primarily interested in the promotion of lime as a means of increasing our tonnage.

Can promoting and selling be done by the same man? When we ask this question do we mean "Is it possible for the promoting and selling to be done by the same man," or do we rather mean "Is it feasible for promoting and selling to be done by a representative of an association of a number of manufacturers?" I rather think it is the latter question we have in mind for when it comes to the possibility of the same man promoting and selling we might ask, is it possible to promote the use of lime without selling it?

There are advantages to be had in having the same man promote and sell. There are disadvantages. Apparently the disadvantages have outweighed the advantages in the judgment of this Association for it has been a very sacred policy of the Association to prohibit sales on the part of Association promotion men.

Listing the advantages briefly they would appear to be as follows:

(1) It would enable a sale to be made to a prospect when he is warm rather than waiting until he has had time to cool or be worked on by competing commodity salesmen. Under the existing arrangement in field promotion the promotion man gets on the job—he works on the prospect—the prospect warms up and asks "How much will lime cost me?", or, "How soon can I get a car?", or "Where can I put the lime?" When a lime salesman gets a question like that the lime is sold. But the promotion man has his hands tied. His reply is "Here is a list of members of the National Lime Association, anyone of them make good lime. They meet the standards of the American Society for Testing Materials," and then he goes back to his hotel and writes a report. The report goes in to Association headquarters. In the course of a week or two a bulletin goes out from headquarters to the member companies. A salesman of a member company calls on the prospect. If it was a building, he finds the building up and occupied, the bricks laid up with a patent mortar, the walls plastered with hard wall plaster and cement stucco on the exterior. If the promotion man could sell the lime when the prospect is first warmed up to lime, it would be a different story.

(2) It would eliminate any possibility of "passing the buck" between the promotion man and the salesmen of member companies on jobs where the lime loses out. In the procedure outlined previously the salesman says the promotion man did not sell the idea of lime to make it stick and the promotion man says the salesman was either a weak sister on sales or was too slow in following up the tip which was a red hot lead when given out by the promotion man.

(3) It would give the promotion man in the field a definite accomplishment to point to in increased tonnage of lime used. The promotion men we have representing the National Lime Association are to be congratulated on their good work. But they would undoubtedly be spurred on to greater results if they could feel within themselves that they were accomplishing something.

(4) It would give the manufacturers of this Association definite and tangible results in tonnage figures. If the accomplishment of the promotion men could be set before this meeting today in figures of tons of lime sold by promotion men in various districts the discussion we are having would undoubtedly be unnecessary, for then we would know if we were getting results.

In short, the actual sale of lime by the promotion man would eliminate a great number of intangible factors and put the whole promotion problem on a brass tack basis. I will only attempt to list what disadvantages suggest themselves, leaving elaboration on these points to the discussion.

About the first question to suggest itself is, "If the promotion man is to sell, for whom will he sell? How would the tonnage be divided and by whom?" Another question would arise, If a promotion man starts work on a prospect and a salesman from an individual company appears on the ground without previous knowledge of promotion man's work, who is to retire? And another, Would competition between promotion man and individual company salesman be desirable? If the promotion man sells, it can easily be seen that there would possibly arise many questions of fairness of tactics and possibly distrust.

Undoubtedly there are other questions in your minds. It is difficult to visualize a promotion man sent out as a representative of the National Lime Association selling lime and a distribution of the fruits of his efforts made fairly among the members of the Association. It is not difficult to see, however, that if the salesmen of individual member companies can be equipped with the same data and information which is now supplied the Association field men, the promoting and selling of lime can be accomplished to the satisfaction of all.

What Variations in Method Must Be Recognized For Promoting Uses of Lime in the Construction, Highway, Agricultural and Industrial Fields?

By G. B. Wood

In discussing this subject Mr. Wood stressed the fact that there is not one best method for all cases. One method might be best for a particular situation but most frequently a combination of two or more methods will be needed to secure the maximum results.

In the construction and highway fields the lime manufacturer is selling practically in every instance to the consumer through a dealer. In this situation Mr. Wood claims that the lime manufacturer must have salesmen to call on the dealer and should also have salesmen or promotion men that can go direct to the consumer and thus stimulate demand. The same man can promote and sell when representing an individual company but this situation does not hold when the man represents a group of manufacturers. The man representing a group can only promote. The group representative may be the most economical method to reach the consumer. Promotion work is of real value to the dealer but few of them appreciate it as a factor in increasing their business. The lime manufacturer must consider promotion entirely from its effect in increasing his own market.

In serving the agricultural field not only the dealer must be considered but also the county agent. The market problem may also include agricultural schools, agricultural experiment stations and the department of agriculture. These agencies are all important and special attention should be given to complete cooperation. The group promotion plan appears to fit these circumstances best, as the problem is to get lime recommented and used as a soil conditioner in a given territory and then to follow through with the sales work favoring a particular manufacturer's product.

Lime used in the industries, especially the chemical field, is sold direct to the consumer and sales and promotion can generally be given to the same man. However a man of high grade research caliber representing a group can do a great deal of excellent work in promoting the greater use of lime and advising on the better use of lime and assist in working out problems of the consumer arising in the processes involving the use of lime.

Mr. Wood stressed the value of the present literature which the National Lime Association has compiled for the use of salesmen in promotion work. The individual company is limited in its contact to working conditions and particular results involving the use of lime, and because of this condition Mr. Wood personally recommended the group cooperation plan even to the extent of different groups cooperating with one another.

Will Promotion By Individual Companies Do Any Lasting Good for Industry?

By M. McDermott

With the present grade of salesmen employed to sell lime, Mr. McDermott was quite skeptical as to the value of promotion by these salesmen as representing "individual companies." The average salesman is a disgrace. He lacks education and ability to handle effectively the literature placed in his hands. A higher type of salesman is needed and such a salesman armed with the proper literature can accomplish good of a lasting character as a promotion man for an individual company.

Will the Industry Be Served to Advantage by Group Promotion?

By R. C. Bye

As a newcomer in the lime business, I am entirely lacking in the experience that most of you have had in promotional work for lime products. I have, however, both read and heard many discussions, with many conflicting opinions, all seemingly sincere and well-founded.

It struck me that similar opinions aligned themselves into groups, and the most important factor in this alignment seemed to be the market under consideration. In other words, customs and economics in addition to nature of products, freight rates, etc., are important factors of varying weights in different localities. Even the promotional sales policies of an individual producer are not always the same in his several markets.

There does not seem to be any question but that the strength and economy of promotional work of any kind is directly proportional to the number of reputable manufacturers participating. The problem, therefore, resolves itself into the bringing together of all of those manufacturers whose interests in a common market are the same. Carried to an ultimate conclusion, this would result in many promotional groups, divided according to markets. A large individual producer might well be a member of several groups, with different policies.

Full value of promotional groups, however, can be realized if they are tied together by both district and national organizations, acting solely in advisory capacities. Is not the answer a united group of lime manufacturers just as a United States of America?

Is There Any Advantage in the Broader Scope of a District Promoting Plan?

By S. W. Stauffer

Confidence in the future was expressed in clear and sane terms by Mr. Stauffer. "Our failure to accomplish more has been due to a lack of concerted effort, cooperation, belief in fellow manufacturers and of sufficient supervision of the National Association work." The convention offered an opportunity, claimed Mr. Stauffer, to pause and take inventory and to discount the selfish purpose of promotion.

The advantage in the broader scope of a district promotion plan is found in the fact that it permits a close contact between lime manufacturers and this close contact means fear and suspicion. Such a district is limited by the markets which can be reached economically, the similarity of products and the proximity of lime manufacturers to each other. The country is too wide for effective national association contact. There might be occasions where the work of one district would clash with another but such instances can be adjusted to the satisfaction of the districts involved. "Limit your efforts—don't broaden your markets unduly—don't seek the other fellow's market without an analysis and an ethical approach," was the advice of Mr. Stauffer and he carried the point to a conclusion by stating that a united effort is far greater than any individual effort.

Can National Promotion Be Expected to Serve All Interests Satisfactorily?

By G. J. Nicholson

In approaching this subject for a few minutes discussion, we shall of necessity make a few divisions. The first will be a brief analysis taking the view point of the buyer of the commodity in which we are all so vitally interested. Lime promotion must be so arranged as to create in the mind of the buyer an absorbing subject, standing out prominently so as to keep before the buyer the benefits and results to be derived from the product at all times. The promotion should so be worked out that the buyer will be thinking of this commodity as the one and only one which is most proper for him to use at all times and in all places and the best that the market offers. This can only be accomplished by a well-defined and regulated analysis, the analyzing of which must come first from a centralized head, such as the National Association has in the past afforded, and the promotion of this idea should tend to serve all interests more satisfactorily than though it originated in various groups.

In analyzing the situation further, the buyer's attention should first be obtained through an extensive program of sales promotion, this program to be so arranged as to hold the attention of the buyer until he is gradually converted to the use of the product. The attention must first be national in scope so that the member companies will, in turn, be able to hold the attention of the buyers by individual groups.

The second thought to consider is how we, by national promotion, can best find a method measuring the public with which we deal or hope to deal. National promotion, well directed, should supply the material for the groups or district, thus enabling the districts with the help of the national to geographically arrange the sales possibilities. Facts should be gathered, showing where and what kind of lime the community or the manufacturing district requires and which is best adapted for that particular manufacturer's use.

The next step is to arouse and hold interest in the commodity. The first law of interest—how to create this degree of interest within the mind of the buyer—is the question before us. The answer may be found in two psychological laws. The first is, in order to create interest in a thing, give information about it. This has been so well started by our national promotion that it is nothing less than tragic that we should now cut down our appropriations, which means a step backward instead of forward.

The second law is interest. This is another psychological law. In order to create interest in a thing, arouse activity towards it. We may see this law exemplified in the methods pursued by various organizations in enlisting the interest of certain persons. When a hospital desires to secure a wealthy patroness, it places her on its force, then on some important committee. As she busies herself with the affairs, she becomes interested in it and soon makes the hoped for contribution. Just so, if national promotion is well directed, interest will be aroused and there will be activity, not only in the districts but with the individual manufacturer, thus creating a desire for knowledge of the product and the methods of distributing it to the public.

In closing, perhaps we can boil down the situation that national promotion is no more than skilled advertising. Ernest Elmer Calkins in his article in the Atlantic Monthly, entitled "Business has Wings," writes as follows:

"Today the most pessimistic cannot ignore the signs of prosperity. The business world is saying 'every day in every way, business is growing better,' and paying to say it. At the close of 1926, Cyrus Curtis employed a page advertisement in numerous newspapers to announce that more space had been booked for 1927 in his three publications than ever before in their history. A manufacturer has stated that he will spend in advertising this year the stupendous appropriation of $25,000,000. Such incidents as these are more than indices of prosperity. They are quaranties that prosperity will be produced. They are causes rather than effects, but they reflect the belief of men who back their belief with their money, and by so doing, make their beliefs come true. We have realized at last that prosperity is not merely wealth or goods or high wages. It is money in action exchanged for goods. Securing prosperity by advertising for it is at least as certain as securing any other concerted action by the same means. When everybody is pessimistic, business is bad; when everybody is optimistic, business is good. Business continued to be good as long as people think it is. If they can be made to continue to think it is, as they have been made to think they want motor cars or silk stockings, then business cycles of alternating good and bad kinds will become as obsolete as bicycles."

How Can Literature Be Financed Under the Group Plan?

By J. M. Deely

The answer to this question naturally depends upon the type of literature which would be published. Literature could be classed under two main heads, namely:

(1) A general class of bulletins which would serve all groups.

(2) A particular class of bulletins to meet the special demand of a certain group.

Bulletins of the general type, such as those which the Association has been publishing, could be financed in the usual manner, that is to say, each member company paying for the number of copies ordered. If there should be a demand for a type of bulletin such as watertight concrete or any new bulletin, the difficulty would be to get a 10,000 minimum, which is its most economical form; unless each group pledged itself to take a definite percentage for its use, cost would run up for small numbers of bulletins.

Under class two, a special bulletin would be prepared to meet the requirements of a particular group. Naturally this group would, in conjunction with the Association, outline the type of bulletin desired. The copy of this bulletin could be prepared in the group or by the individual company, and the Association, through their past experience, could give a probable estimate of the cost in getting out these bulletins in 10,000, 20,000 or 50,000 copy lots, and cooperate with the cover, art work and other details to put the whole thing in a presentable form. A canvass of the interested groups would first be made to determine the number of copies desired. On this basis, the group would guarantee to subscribe to a definite number of copies.

Perhaps a bulletin written specially for a certain group would prove satisfactory for another group. In such case, with the consent of the former group, the bulletins would be issued at the price made to the original subscribers. However, since the cost of getting out the second edition would be less than that of the first, the profits derived should be divided so that half would go to the National Lime Association, while the other half should be put to the credit of the original group.

I am asking for literature of the popular type, simple in form, attractive in design, easily readable and equally easily understood by salesmen or by the people with whom they have contacts, whether they be architects, contractors, or boss plasterers. This will utilize the information compiled by the National but put in simple, readable form. The salesman's manual should be an A B C book which can be used directly and simply in sales effort, and should be as well an A B C book for mechanics. Books of the type of the Red Book of the United States Gypsum Company and several of the manuals of the cement companies seem to me to answer this demand. They are popular, they are asked for by the mechanics, and best of all, they are used constantly by them. Dealers keep them on their desks for reference for specifications or to answer direct questions as to uses.

If we had in one bulletin, including specifications for mortar of various kinds, plastering specifications for lime stucco, specifications for lime and specifications for concrete and other of the major uses of our product, developed in the proper form, indexed for reference, we should have a bulletin which would, in my opinion, have an appeal and be universally used, and universally popular.

Can a Specialty Group Operate Without Friction With a Market Group in the Same Territory?

By J. J. Urschel

Experience enabled Mr. Urschel to discuss this subject with authority. "Live and let live should be the dominating attitude. Be fair, be honest, don't hog it all and the troubles will be little." Mr. Urschel expressed his faith in the district plan largely because in his opinion it afforded the only effective means of securing close personal cooperation. The industry should have a head, however, and preferably a man that can direct the district groups with a firm hand. "Remember 100 per cent cooperation and honesty not to be expected. It must be a policy of give and take."

How Can Promotion Men Work Closely Enough with the Salesmen to Insure that the Lime Will Be Sold as it is Promoted, without Playing Favorites with the Members and without Giving the Appearance of Playing Favorites?

By S. M. Shallcross

Every individual, every manufacturing company progresses so long as it follows economic law; as soon as economic law is run counter to, then the individual or manufacturing company loses out and will exist only so long as its assets will last. Upon economic law must we, as individuals and manufacturers, base all our policies and actions. This is the fundamental law, the all embracing law; it covers all forms of human and physical reactions; it embraces the law of the Conservation of Energy as well as the Golden Rule.

In a recent issue of Forbes Magazine tucked off in a corner was a paragraph which deserved greater publicity. It stated: "It's a pity private business is not as well, as fairly, as expeditiously managed as the business of the public service corporations. What a lot of villainy goes on in private business! How little, in comparison, in the public service corporations!"

Why this difference between private business and public service corporations? The answer may be found in analyzing the forms of competition experienced by each. The public service corporation has to combat but one form of competition, that of economic law. Within their territory, taking the case of power corporations, they must supply power cheaper than the isolated plants of the consumer. Only by economic manufacture and distribution of power can they hold their business or increase it. The lure of large profits does not blind them, because their profits are limited by law.

All types of industries have economic competition; like taxes, they cannot escape it. Also, like indirect taxes, the magnitude of economic competition is seldom realized. Its magnitude is many times greater than the competition between individual plants in a given industry. It is an irresistible force and, therefore, must be recognized. Every industry is threatened by it—For example,

1. The coal industry; the economic use of coal has curtailed enormously the growth, from the standpoint of tonnage, of this industry.
2. The motor industry; the development of a gas

turbine or a Diesel engine adaptable to motor vehicles may revolutionize this industry.

3. The phonographic industry. The competition of radio instruments, undoubtedly, caused an enormous unknown loss to this industry, although it looks like the Victor Company has found its economic position.
4. Every chemical industry faces the danger of having its major products become the by-product of another industry.
5. The cement industry; I have been told, but have not verified it, that only from 15% to 20% of portland cement has hydraulic properties. If it is true, then some invention may cause four out of five cement plants to become idle.

While industry today is threatened on all sides by economic developments, we should not become panicky. The basic industries should be in a better position than processing industries and industries depending, in large part, upon patented machines and processes. Our lime industry is a basic industry, and therefore, we should have only optimism for the future. However, all our policies in manufacturing and distributing must be fundamentally sound or we fail. Cool heads must direct us in conformity with economic law.

So far, we have confined our talk to economic law and economic competition in ints broadest sense. As they are impersonal subjects, so long as we confine our efforts to them, we will become an amicable family, like the public service corporations. There are other forms of competition which are personal in high degree, but which, nevertheless, must be faced. I have divided these additional forms of competition into two classes:——

1. Competition between industries.
2. Competition within industries.

Competition Between Industries

Competition between industries may or may not be economic. The use of steel rather than wood in large buildings is a necessity and, therefore, it would be futile for the Lumbermen's Association to promote wood for that purpose. Usually the problem is more difficult. There is an economical balance between not only cost but also advantages.

The evaluation of these two items in themselves is not easy, but to evaluate them together is in most cases impossible. Seldom will two men agree as to the probable erected cost of two competing materials. The advantages of different materials can seldom be priced in dollars and cents; and yet, in order to compare competing products, a common denominator for cost and advantages must be found, or the decision is made on sales argument. It is the function of the association promotion man to attempt to find the common denominator.

The promotion man acts as a buffer and a leader in the struggle between industries. His work is actually disinterested, and if he were promoting an absolutely uniform commodity it would appear disinterested. However, where he is promoting a commodity of variable analysis and characteristics, his work will always appear partial. Actually, if he uses scientific methods, he should determine the best product for a given application and concentrate on promoting that product against the product of the competing industry. If he does not concentrate on the best product he is easily sidetracked from his main purpose, and as the presentation of his case is weakened, is unconvincing. Such a promotion man is a failure as is likewise the industry which he represents. After the product is established normal competition within the industry will give each company its share. Charges of partiality result from causes due to competition within the industry. We should be broad minded enough to ignore such charges.

Competition Within Industries

Industrial economists tell us that prices are set by the marginal producers. That is, market prices equal the cost of the most inefficient producers. If this were true, we would have no failures. Market prices are located at a point below the cost of the most inefficient and above the cost of the most efficient. Our industry always has plants that are retrogressing. We continually have some plants that are progressing and some that are retrogressing. This is a self evident fact; we know there can be no standing still.

The producers that are progressing are building for the future. They believe in National Associations and promotion men. They are seldom the ones that advance charges of partiality, because they know that promotion men and themselves are working for the future, and they are ready to pledge all their resources for the future.

What of plants that are retrogressing? For the good of the industry they should declare all cash received above operating cost as liquidating dividends and then scrap their plant. Some lime plant operators may recognize their situation and may have established a liquidating policy. If they have faced the facts, then naturally, they are not interested in promotional work and they cannot be blamed for wanting to get all the tonnage when they can.

In discussing economic law and economic competition it is easy to become confused by our own interests and go off on a tangent. Emerson has given us the classic parable of the man making mouse traps in the wilderness and the world laying a concrete road with ten per cent hydrated lime up to his door. Then the advertisers upset our beautiful conception of economic law by stating that Emerson was wrong and that if he didn't advertise he would have to eat the by-product of his invention or starve. But Emerson is in good standing today, because with the development of radio, the advan-

MILLS AND QUARRIES
HOMELAND, VIRGINIA

SUNSHINE LIME COMPANY

Homeland, Virginia

Date ______________, 192___

To ______________________________________

____

We quote, subject to change without notice, shipment within fifteen (15) days from date of order, acceptance of order in writing by this company, and terms, conditions and limitations on the reverse side hereof, the following prices on SUNSHINE brand lime in carload lots, F. O. B. cars at ....

....

		Cars under 25 Tons	25 Tons and over
BULK lump quick lime, for structural uses	per ton	$	$
WOOD BARRELS, lump quick lime (180 lbs. net)	per barrel		
JUTE SACKS, lump quick lime (2 sacks, 180 lbs. net)	per barrel		
STEEL DRUMS, lump quick lime (180 lbs. net)	per drum		
MASON'S HYDRATED lime (in 50 lb. paper sacks)	per ton		
——— **FINISHED HYDRATED** lime (in 50 lb. paper sacks)	per ton		
DAINTY PACKAGE HYDRATED lime (8-10 lb. sacks in carton) ..	per carton		
DAINTY PACKAGE HYDRATED lime (10-lb. sacks not in cartons) ..	per ton		
BULK, lump quick lime, for chemical uses	per ton		
....			
....			

NOTE—

Cars may be mixed, if desired, at prices quoted above. Minimum car in interstate traffic must contain 15 tons, minimum car in intrastate traffic must contain .... tons; otherwise buyer pays difference in freight.

Railroad weights shall govern net contents of car and invoices will be rendered accordingly. Paid freight bill must be returned for credit.

TERMS—

On approved credit shipment will be made on open account payable net cash thirty (30) days from date of shipment.

DISCOUNTS:

Provided no overdue accounts are unpaid, you may deduct the following discounts for full cash payment of invoice within ten (10) days after date of shipment.

BULK lump quick lime (structural)	cents per ton
BARRELS (wood, jute and drums)	cents per barrel
HYDRATE (Mason's, Finish and 10-lb. sacks, loose)	cents per ton
DAINTY PACKAGE (Hydrate 10-lb. sacks, in cartons)	cents per carton
BULK, lump quick lime (Chemical) after freight deducted	per cent
....	
....	

This quotation also applies to specific work requiring deliveries beyond fifteen (15) days, but must be accepted in writing within fifteen (15) days from the above date, and is subject to the execution of our regular contract form.

Prices quoted herein are based on freight rates in effect on date of quotation and are subject to revision if the basing freight rates are changed.

Yours respectfully,

SUNSHINE LIME COMPANY,

Sales Manager.

Sample Standard Form for Quotation Submitted by W. E. Carson to the Lime Industry for General Adoption.

CONDITIONS AND LIMITATIONS

PAYMENT:

If, at any time, the financial responsibility of the Purchaser become impaired or unsatisfactory to the Lime Company, it reserves the right to require payment in advance, or satisfactory security or guarantee that invoices will be promptly paid when due.

If Purchaser fails to comply with terms of payment, the Lime Company reserves the right to cancel unfilled portion of any contract or order, Purchaser remaining liable for all unpaid accounts.

CLAIMS:

For loss or damage will not be considered unless supported by seal record and Railroad Agent's acknowledgment on freight bill. Freight overcharge claims must be accompanied by original receipted freight bill and bill of lading.

SHIPMENTS:

Orders entered for shipments on a specific date will be shipped on that date unless ordered out sooner by Purchaser.

The Purchaser shall give the Lime Company shipping instructions in writing, a reasonable time before shipments are made.

The Lime Company shall have the right to direct the route by which all shipments hereunder shall be forwarded.

The Lime Company shall not be responsible for delays in manufacture or shipping due to strikes, differences with employees, scarcity of labor, accident, inability to secure cars, coal or material, fire, flood, warfare or other causes not under its control, nor for any delay in transportation.

SPECIFICATIONS:

Unless otherwise agreed, and in that case manner of preparation will be recorded below, the lime to be furnished hereunder is, when shipped, to conform in every respect to Standard Specifications for High (Calcium) (Magnesium) Lime as adopted by the American Society for Testing Materials when tested by methods of testing recommended by said specifications, but Shipper or Seller cannot be responsible for improper use of Lime, therefore will not guarantee finished work.

SPECIAL PREPARATION, Viz:—

Wording for Back of Form on Opposite Page.

tages of the mouse trap were broadcasted at a cost of only $5,000.00 per hour and gas station sites are at a premium along that road today.

Advertising and promotion are needed more today than ever before. Our lime association by continually advancing economic facts compelled the recognition of larger percentage lime mortar and the economic advantage of lime plaster over gypsum plaster. But the news of the reduction in our dues leaked out and was interpreted as meaning the dissolution of the lime association. Today competing industries are intimating that the dissolution of the Lime Association is evidence that our products are not fundamentally economically sound.

Our products may be, economically, the best, but unless we compete in the promoting of them against the promotion of other products we run counter to an economic law, the survival of the fittest. Be sure of it, that every weakness shown by an industry will be pounced upon and turned to the advantage of another industry.

Let us summarize. Economic law is the fundamental law by which we grow or are destroyed. Our product or products must first be products that are economically sound. Our manufacturing and distributing policies must be economically sound policies. Anger and passion have no place in economic law. Those whom the gods would destroy they first make mad, and the principle of the survival of the fittest is as prevalent and as necessary to-day as in the early years of human existence.

Narrowing our discussion: Our competition with other industries must be met by our promotion men. Criticism of their work will be found to originate from narrowmindedness, or in other words, from a retrogressing management. Finally, our products must be fundamentally sound products; they may have great possibilities, but unless they are aggressively promoted, they will fall short of their possibilities.

Should Salesmen Call on Prospects With Promotion Men?

By E. C. Carter

When promotion men or field men under orders from their home office are promoting the uses of lime, a salesman for a lime company should not under any circumstances accompany or make calls with him. Should a sales representative of a lime company meet a promotion man while they are working in the same territory, the promotion man should not permit the sales representative to accompany him upon any of his calls nor give him any information with reference to any prospects. Should this be permitted, it would certainly lead to dissatisfaction among member companies, and the charge might be made that the field man was favoring a company or a certain salesman.

All prospects worked out by field men should be promptly reported to all member companies. You will agree it is practically impossible to secure salesmen who have had sufficient technical training and experience to enable them to handle successfully prospects who are considering the use of lime for Highways, Construction, Chemistry, or Water-Softening. Our Association has considered promotion along these lines of sufficient importance in the past to employ men trained in each of the four departments.

A salesman for a lime manufacturer digs up a prospect for the use of lime in highway construction but knows he has not sufficient technical training and experience to enable him to land the business. He immediately reports this prospect to his company and the company wires or writes to the Washington Office asking that a field man in this department be immediately assigned to go with the salesman, furnish the technical information the customer desires and help the salesman land the business. This is just the kind of help needed by the sales force and it is without doubt one of the most important helps for which the Association is formed and for which the member companies are paying their dues. The requests for help received at the Washington Office should bear the receiving stamp showing date and hour the request is received and assignments of field men made in rotation as the requests are received at the office. By following out this plan there could be no charge made by any member company that favoritism is being shown by any of the officers or field men of the Association, for the field man and salesman will never make calls together except upon request made by a member company and the assignment of a field man made by the home office of the National Lime Association.

Therefore, the answer to the question as asked "Should salesmen call on prospects with promotion men?" is "no." However, considering the matter along the lines of the explanation as made above, promotion men can call on prospects with salesmen.

How Can Groups Promote the Idea to "Sell Somebody's Lime," Meaning to Sell a Job for Another Member Rather Than Have It Lost to a Competitive Material?

By J. M. Gager

Not many years ago, each one of you will remember, much of our demand came from the structural uses of lime. In the main it was for plastering, with a large amount also going into mortar, for tile and tile work. But suddenly, this demand disappeared seemingly, first one and then another explanation was offered to console our shrinking tonnage accounts, yet the startling fact remained that our losses in this field continued to mount bigger as each season's record was analyzed. Now we decided to look for the cause and, if possible, provide a remedy. It was soon seen that the gypsum industry, through concerted effort among its membership and aided by intensified sales promotion, had quietly but surely taken out of our hands all the plastering demand, thus relieving the lime industry of its major tonnage, which we have never recovered. Did we bring about any concerted attempt to stay or even offer effective means to discourage this departure from our channels of demand? No, not one; that is to say, nothing of a permanent nature was created to combat this new competition; hence today no demand remains with us for this use, other than the white coating work which goes to the mills in Ohio making finish lime. To further endanger our position against this gypsum competition, which was new only a few years ago, it is my positive knowledge that certain lime manufacturers in the South now have sales arrangements with more than one of the larger gypsum mills under which these competitors are privileged to sell against us at equal prices, though not having a cent invested in the business. Is this not fundamentally unsound? Certainly it lends no stabilizing influence to our market; in fact, the undercurrent is bad and stands as a positive contradiction to the main ideals of every lime manufacturer.

But the above hasn't been our main disappointment. Following on the heels of this gypsum procession, we soon found another contender in the field. This time it was something new, what we will call patent mortar, a combination material used for brick and tile mortar, and though at first we ignored their continued identity on one job after another, it soon dawned upon many lime manufacturers that this competition was beginning to make noticeable progress. Lime manufacturers grew restless and again tried to combat this new competition; but in vain. Of course, you ask why wasn't something done? I will say because of the utter lack of cooperation within our own circles. Petty jealousies, together with prejudices of one kind and another, have kept our ranks torn asunder, leaving these and other competitive materials to make serious inroads on our business. Meetings have been held repeatedly for the purpose of organizing our forces so funds and talent could be provided to carry on the educational work of our industry, but even in this effort we have failed miserably. Pledges have been neglected, in instances openly repudiated, leaving deficits so large our field forces were reduced to a pitiable machine, stripped of the necessities which they should have to carry on and acting as a restraint to their efforts. Naturally this left various forms of dissension, none of which our competitors were slow to discover, and as far as I can see, they have lost no opportunity to capitalize on our infirmities. Had it not been for the growing use of lime for chemical purposes, where would our industry be today? I repeat, gentlemen, and I want you to think over my question again, right now, what would your business amount to today without your chemical clientele? Nothing to speak of, I would venture to say, if your experiences have been like the Gager Company. But the hour is not too late; starting now, as a matter of course, leaves us handicapped, yet we must assume the responsibility which rightfully fits on the shoulder of every man sitting in this room and I am ready to join with you in the pledge that we will immediately meet in serious thought of these growing dangers and provide now, not next year, whatever remedy is needed to earn a more reputable place for lime in the sight of structural projects. Chemical lime, which is our savior, must also be seriously considered and means provided to widen the uses to which lime is already put and bend forth every effort to create the many uses still undeveloped but waiting anxiously for us to open the way.

All this brings us to one common thought, and that is "Sell Somebody's Lime." Don't allow competitive materials to gain further headway. If your lime isn't suitable, tell your neighbor and even help him get the contract. It will surely help you later and does just that much more to further ab-

(Continued on Page 60.)

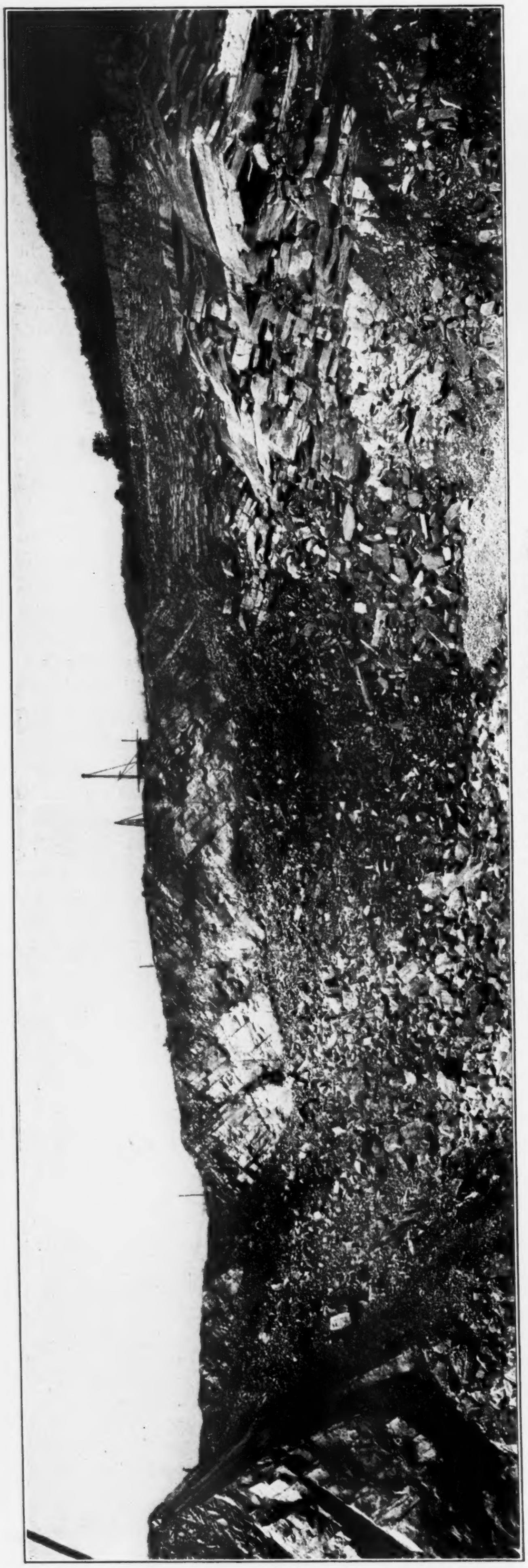
COMPLETE AND EFFICIENT HYDRATE PLANT OPERATED BY CHEMICAL LIME COMPANY

By H. W. Munday

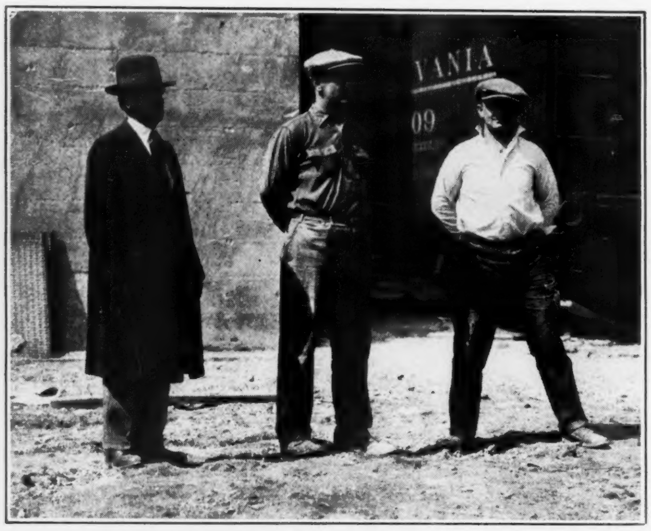
BELLEFONTE, Pennsylvania, can lay claim to another distinction in that it has one of the most complete and efficient hydrating plants in the entire lime industry. This is the new hydrate unit of the Chemical Lime Company. This hydrate unit is housed in a separate new brick building that bristles with its neat appearance. There is absolutely no dust to be observed in the process, so there are no offended neighbors. This hydrate plant was built by the McGann Manufacturing Company and consists of Schulthess hydrator, Hummer screens, two steel storage tanks, Bates packers and the necessary conveying units. The significant fact is that the lime can be taken just as it comes from the kilns and fed to the hopper without any preliminary crushing. The Chemical Lime Company makes a pebble lime, and when this lime is being produced, the lime from the kilns is crushed by a Sturtevant rotary crusher; the pebble lime is removed by the Hummer screens; and the balance passes to the hyrator. The hydrate plant is arranged, however, so that all the lime from the kilns can be sent direct to the hydrator without any preliminary crushing.

The plan of hydration is quite simple. The lime is taken from the kilns and dumped into a hopper located in the kiln building and elevated vertically and then conveyed horizontally to the hopper of the hydrator in the hydrate building. The lime passes from this hopper to a revolving screen in the breakdown compartment of the hydrator. Here water is added to the lime and the actual breakdown occurs. All of the lime one-quarter inch and less is conveyed by a ribbon conveyor, which surrounds the screen, to the treatment zone of the hydrator. In this treatment zone the accumulated steam generated in the screen section when the lime and water meet acts as the H_2O supply for the broken down lime which has already left the screen. When the lime meets the water, pressure results. A small quantity of this pressure rushes to the condenser and stack outlet. Here the uprush of steam is met by a baffle which turns back any particles of lime that may have been lifted by the explosion. If, however, the lime laden pressure still continues to find a way of outlet, it is met by sprays of water at different heights in the condenser column. When this lime meets the sprays of water, it drops as

View Showing Part of Quarry and Incline to Initial Crusher. The Conveyor from the Crusher to the Screening and Secondary Crushing Plant is Enclosed in the Housing in Background.



An Excellent View of a Part of the Quarry After a Large Shot.



Left to Right—J. S. Walker, S. H. Smith and John Weber.

heated milk of lime to the bottom of the condenser and is fed by a pipe into the revolving screen section of the hydrator to furnish heated water for breakdown.

The balance of the steam that is generated in slacking in the screen section rushes into the treatment zone of the hydrator. When the broken down lime is conveyed by the ribbon conveyor into the treatment zone, it satisfies itself, because of the temperature differences, with the condensed steam which was generated in slacking and which now is confined in the treatment zone. It receives full satisfaction for its H_2O content under as near a vacuum as possible.

There are many unusual features in the process. The hydrate is satisfied with moisture content by treatment in its own steam. It is treated without the presence of foreign particles which are rejected in the screen section. Core and underburned lime are eliminated in the screen section. Because the lime is broken down naturally by water, fines are eliminated.

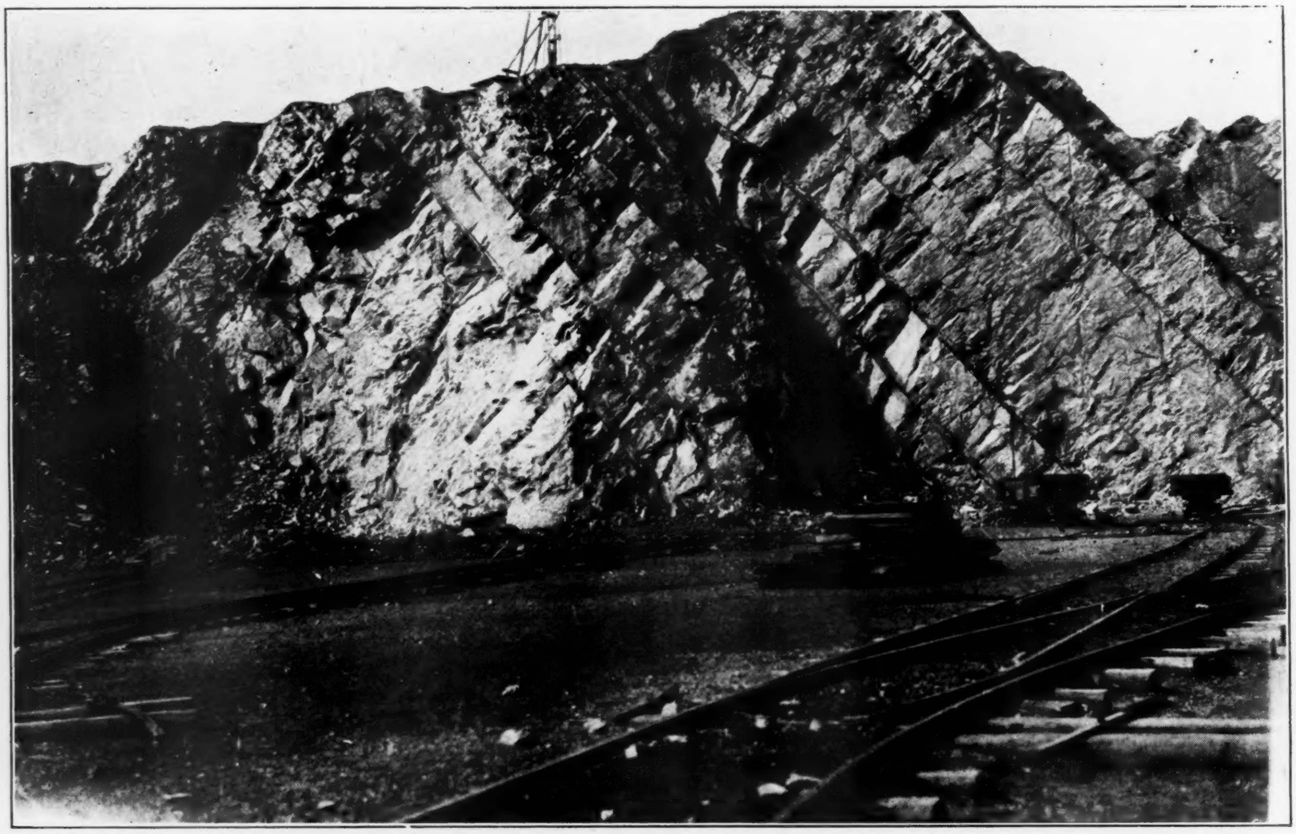
The storage facilities in the hydrate plant consist of three raw tanks, two of which have a capacity of 100 tons, and one a capacity of 150 tons. The finished hydrate is contained in either of two 80 ton steel tanks from which it is drawn and bagged by two Bates packers of four units each directly under the tanks. Two McGann mills are available when a super-hydrate is desired.

The Chemical Lime Company manufactures a long list of products including pebble lime, ground lime, granular lime, mason's hydrate, chemical super-hydrate, chemical lime, agricultural lime, fluxing stone, ballast, road stone, etc. The hydrate plant has a capacity of 125 tons per 24 hour day. The crushed stone plant which has been in operation for a number of years has a capacity of 400 tons per hour.

The company has 75 acres of quarry property which is part of the famous Bellefonte ledge. The

This is the Hydrate Building. The Material is Elevated Vertically and Then Conveyed Horizontally from the Kiln Building at the Right and Discharged Direct to the Hopper of the Hydrator.

Showing in Detail the Results of a Large Shot. The Blasting Practice at This Quarry is Particularly Efficient. Note the Uniform Size of Stone.



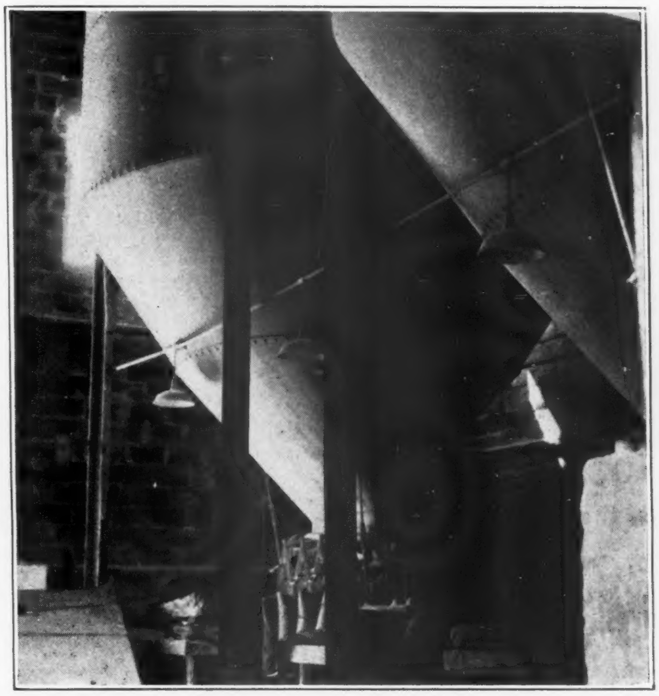
An Interesting Quarry View. Note the Dip and Compactness of the Stone. This Stone Blasts Beautifully.

Kiln Battery on Left and Hydrate Building on Right. The Bridgework and Housing Shown in the Center is the Horizontal Conveying Unit for Transporting the Lump Lime to the Hydrator.

stone varies from dark to a light dove color. It is a compact limestone of excellent quality. An interesting feature, as will be seen in one of the illustrations, is the dip of about 55 degrees to the north.

Three Erie steam shovels are used in the quarry for loading the stone. Loomis well drills are used for blast hole drilling while Peerless explosives and Cordeau Bickford safety fuses are used in shooting. Sullivan, Hardscog and Ingersoll Rand hammer drills are used for secondary shooting. A Sullivan air compressor supplies the air for secondary drilling. Baldwin, Porter and Vulcan locomotives handle the transportation of stone to the kilns for burning. The kiln stone is all hand picked. A battery of ten kilns each with a 12-foot shell and a 14-foot flare are in operation. The kilns are drawn every six hours and have a fuel ratio of 3½ to 1. They are built up on foundations of massive construction to a height of about 40 feet. Each unit is lined with either General Refractory or Harbison Walker refractory brick.

The stone in the quarry not selected for the kilns is hauled up a slight incline and discharged to a 42 by 48 Traylor primary crusher which is operated by a 250 h.p. General Electric slip ring motor. The discharge from this crusher is taken by a Stephens Adamson 350 foot centers ball bearing conveyor and elevated at an angle of twenty degrees and discharged to another Stephens Adamson belt conveyor 800 foot centers which discharges the product to a Traylor 32 feet by 60 inch scalping screen. This screen has a jacket 20 feet long. Flux



The Two 80-ton Steel Tanks for the Finished Hydrate with Packing Machine Below.

and ballast stone are separated here and dropped to bins. Other sizes are reduced by a number 7½ Traylor gyratory and a number 5 Austin crusher. Austin, Jeffrey and Hummer screens operate the various other sizes of stone. A conveyor discharges the chips to outside storage. All units are separately operated and electrically controlled. General Electric motors are used throughout. All belt con-

The Hydrate Building at Left and the Kiln at Right. Note the String of Cars Being Discharged Into the Top of the Kiln. Little Smoke is in Evidence Indicating Efficient Burning.

The Secondary Crushing and Screening Plant. The Overhead Discharge Conveyor in Foreground is for Chips. The Hydrate Building is Shown in the Left Background.

This Shows the Elevating and Conveying Unit from the Kilns at Right to the Hydrate Building at Left. Shipments Are Made by Rail from Either the Hydrate Plant or Kilns as Shown Here.

veyors in the crushing plant are of Stephens Adamson manufacture.

While the main theme of this article has to do with the hydrate plant, these few details of the crushing plant and quarry are presented because they indicate a low cost of production and a modern layout. Another item of interest is a building set aside for the men where they can eat their lunches, smoke and gather for discussion. Complete machine and blacksmith shops are maintained enabling the company to make all their own repairs.

The officers of the Chemical Lime Company include A. C. Mingle, president; J. S. Walker, secretary, treasurer and general manager; A. P. McNitt, vice president; and R. S. Walker, assistant general manager. S. H. Smith is plant superintendent and John Weber is assistant superintendent.

National Income for 1926 $78,649,000,000

The national income of the United States was $78,649,000,000 in 1926, as against $77,315,000,000 in the preceding year and $70,768,000,000 in 1924, according to a study of national income and wealth made by the National Industrial Conference Board. While this estimate of income is lower than some others recently published because it is based on the growth and production rather than on money incomes, it reveals the significant fact that our greatest increase in national income since 1909 occurred not during the war years or those immediately following, but since 1920, after the "boom" and inflation years were over, prices had been deflated and industry and commerce had settled down to a peacetime and fairly stable course.

Measuring the national income in terms of dollars of constant purchasing power, that is in "1913 dollars," so as to eliminate the violent price fluctuations during the war period, the conference board finds that the "real" national income increased 54.2 per cent or by more than half from 1909 to 1926 inclusive. Dividing the entire time into three periods, it was found that from 1909 to 1914, it increased 91.7 per cent; from 1914 to 1920 only 11.4 per cent, but 26.6 per cent from 1920 to 1926.

National income per capita of population, the board finds, in 1926, in terms of current dollars, was $617.43, and $1,805.37 per person gainfully employed.

The total national income as computed by the board for the after-war period in terms of current as well as in "1913 dollars" for each separate year was as follows:

Year	In current dollars	In 1913 dollars
1919	$68,260,000,000	$38,162,000,000
1920	74,853,000,000	36,641,000,000
1921	55,597,000,000	32,081,000,000
1922	61,633,000,000	37,976,000,000
1923	71,358,000,000	43,715,000,000
1924	70,768,000,000	43,147,000,000
1925	77,313,000,000	45,694,000,000
1926	78,649,000,000	46,392,000,000

This is the Office Building of The Chemical Lime Company.

(Continued from Page 52)

sorb our national production and in that way lends stability to the market, and also provides a reasonable profit on your investment, to which any reputable manufacturer is entitled. Resolve today that your slogan will be to "Sell Somebody's Lime." Lay aside personalities, forget little competitive prejudices, if you have any, and join again hand in hand, positive in your mind that every influence and energy at your command will be focused on the one aim to have lime used wherever it is suitable and leave nothing undone to sell lime, even if the order must go to your neighbor. Maybe it will be yours next time.

Should Membership Be Permitted in Any Group Organization Without Membership in the N. L. A.?

By W. A. Titus

"How can you prevent a group from taking into membership lime manufacturers who will not join the National Lime Association?" asked Mr. Titus. He believed the N. L. A. should be continued but believed that promoting and selling was out of the province of the N. L. A. because of the many different interests and conditions that prevail throughout the country. There is too wide a spread and too much red tape in selling and promotion. Smaller associations of groups with common interests can best promote the use of lime. The N. L. A. should function more as a testing means for setting standards for the various limes.

Mr. Titus, who is a state senator in Wisconsin, created quite a little interest with his explanation of the Wisconsin Cooperative Marketing Law, which permits price fixing and percentage distribution by manufacturers within the state boundaries of Wisconsin. The law applies to all business and it is being used very generally. Mr. Titus advocated a group securing a chemist to supervise the output of lime from the individual members of the group. He further recommended that the different groups cooperate in an effort to reduce the cost of lime so as to better compete with competitive materials. The local or district groups should strive for a confederation of lime associations and this confederation might be the National Lime Association.

If Groups Are to Cite the N. L. A. as Head Will the N. L. A. Set Up a Code of Policies For These Groups?

By A. V. A. Felton

"By all means," says Mr. Felton, "the territories should be remapped and market, geographical lines and freight rates taken into consideration so that a group with common interests can be formed. The National Lime Association can be of tremendous value in standardizing the quality of limes and in carrying on the work of specifications with the other various national bodies."

To What Extent Should the N. L. A. Exercise Supervision Over the Method and Policies of the Group Organizations? Should It Have Any Powers of Enforcement?

By W. E. Carson

Sincere regret that it has become necessary to operate under the group plan and curtail the functions of the N. L. A. was expressed in no uncertain terms by Mr. Carson. The N. L. A. should exercise all the supervision that the finances will permit because at best the group plan is only a poor makeshift, according to Mr. Carson. "The groups will disorganize. Something of a tangible value must be offered. Let us have an investigation by specialists and find out what is wrong and the best plan to correct the situation."

Without extensive supervision by the N. L. A. trouble will come up. Organized direction must be maintained. Lime should be standardized. What is needed is power to fix and enforce a standard by which all lime will be purchased and this standard should be maintained by the National Lime Association. These statements express some of the thoughts stated by Mr. Carson.

A Factor of Increasing Importance

So rapid is our present day progress that even the definition of terms must be altered to meet changing conditions. "Amortization," as it relates to equipment for instance, is that sum annually set aside to provide a fund for the purchase of replacement machinery when such is needed. Ordinarily, the life of machinery is estimated at 10 years, and therefore the annual amortization charge is one-tenth of the original cost. But the rapidity of change in equipment, brought about through development or improvement, makes necessary the modification of this definition. No longer is it safe to base amortization on machine life alone, since the demands of progress may require the replacement of such machinery long before it has worn out.

The producer who installs a certain type of machine may, three or four years after its purchase, find it necessary in the interest of sheer existence to abandon his new installation in favor of improved equipment or totally different methods. His machinery must be sold at great sacrifice, therefore, with the result that the real amortization period is 3 or 4 years instead of 10.

Thus the factor of obsolescence is becoming one of increasing importance. The tendency throughout all industry is to shorten the effective life of mechanical equipment—to fix production costs in consideration of the almost indeterminate amortization period. Naturally, the clearer the vision one can obtain of future operations and the farther in advance the manufacturer can definitely assign his plans, the less will be the losses through obsolescence.

PRESENT PROGRESS AND FUTURE TENDENCIES IN THE LIME INDUSTRY

By Oliver Bowles
Superintendent, Non-Metallic Minerals Station, New Brunswick, N. J.*

EVERY branch of the lime industry from the quarry to the sales office has undergone remarkable changes during recent years. The general tendency has been toward mass production, increased use of mechanical equipment, greater refinement in process of manufacture, and the preparation of products better adapted to the increasingly exacting standards demanded by the consuming trades.

In the quarry, steam has generally given place to compressed air in the operation of drills, and the smaller types of drills have in many places been superseded by churn drills. On low benches hammer drills held in the hands have replaced most of the more cumbersome tripod drills. While in most of the rough stone industries where large quarries are in operation, hand loading methods have given place to loading with power shovels, hand loading has continued with remarkable persistence in the lime industry. There are, of course, many notable instances of power-shovel loading of rock thrown down by heavy blasts in churn-drill holes, but most small to moderate-sized lime plant quarries and many large ones still employ the hand loading method. The main reason for its retention is the facility it permits in sorting the stone and rejecting that of inferior quality. A second reason is the maintenance of a low percentage of fine material, for the hand sledger can break up boulders with a smaller production of fines than can any mechanical breaker. However, the tendency toward larger units, the high cost of labor, and improvements in machines all tend toward an increasing employment of churn-drill blasting, power-shovel loading, crushing, and screening. It is generally recognized that crushers are more economical than explosives as rock breakers, and this has led to the installation of some very large crushers which will handle great masses of rock and thus practically eliminate secondary blasting.

Another notable change is the use of underground mining methods for the production of limestone. This was deemed of such importance that the Non-metallic Station of the Bureau of Mines at New Brunswick, N. J., employed a competent mining engineer to prepare a report covering methods of underground limestone mining. At least twelve large lime-producing companies are now obtaining part or all of their stone by underground methods, and through increasing overburden or the urge of other circumstances others will soon be forced to follow. In the past the quarry industries have unfortunately been somewhat divorced from mining, and this increase in underground work has the indirect advantage of bringing to the lime industry the accumulated knowledge of metal mining.

*Presented before the Symposium on Lime at Richmond, Virginia, April 13, 1927.

Calcination is the most important process in the manufacture of lime. Much progress has been made in overcoming the crudities of the early lime kilns. Increased kiln efficiency has been brought about in several ways as follows:

Better Kiln Design.—The shapes and sizes of kilns have been modified to accommodate a large tonnage of stone, and to give maximum draft with a minimum of waste heat; also coolers have been so designed that the heat of the burned lime is largely conserved.

Effective Insulation.—The better types of modern kilns are so insulated that there is little heat loss through the shell.

Better Firing.—The type of fuel to be used, the arrangement of fire boxes, the time and manner of firing, and methods of forced and induced draft have been studied, and many improvements have been worked out.

Agents for Promoting Calcination.—Both steam and carbon dioxide, introduced beneath the grates, are employed to control draft and temperature in the fuel bed. E. E. Berger, of this station, has recently completed experiments designed to test the value of steam as an aid in calcination. The point is brought out that the advantage gained from steam is in many instances simply an increased draft, which could be accomplished just as well and at much lower cost with an air current. The employment of the Eldred process using carbon dioxide from the kilns seems to offer decided advantages over the steam jet method. The use of the Eldred process and the employment of forced or induced draft would apparently permit the abandonment of many of the present expensive steam-boiler installations, amounting in some instances to the equivalent of several hundred horsepower. Thus a step has been made toward the attainment of a higher fuel efficiency. Much still remains to be done. The conviction is gaining ground that limestone calcination at its best is a highly technical process which will reach its highest development through the services of the physical chemist, the metallurgist, and the combustion engineer.

Hydrated Lime Production Increasing

One of the most remarkable developments in the lime industry is the great increase in the manufacture of hydrated lime. From 30 plants producing 120,000 tons in 1906, this branch has grown to 134 plants producing over 1,500,000 tons in 1925. Although used chiefly in the building trades, it also finds wide use in agriculture and for chemical applications. Hydrated lime prepared at the lime plant is advantageous to the user, because with the employment of special equipment under exact control it is more completely hydrated, of greater purity, and in better physical condition than can usually be attained by the cruder hydration methods commonly employed at points of consumption. It is also advantageous to the producer, for it permits him to utilize to advantage the finely divided lime which, owing to the preference for lump lime, he finds difficulty in marketing as quicklime. It is fortunate for the industry that this development has taken place, for it encourages the promotion of lime manufacture from spalls.

From a few well-known uses that could be counted on the fingers of one hand, the uses of lime have so multiplied that they may now be numbered in the hundreds. When lime is applied to various highly specialized uses it is natural that the required properties will vary. This has led to a broad study of the specific requirements of lime for various uses, and to the establishment of fixed standards. The American Society for Testing Materials, the Bureau of Standards, and the National Lime Association have devoted much study to such problems and many specifications are now available. A supplementary organization known as the Interdepartmental Conference on Chemical Lime has, during the past seven years, developed standard specifications covering a number of important applications of lime. Eleven such specifications had been issued up to June, 1925. The Federal Specifications Board has also formulated specifications along certain lines for the use of government departments.

Properties of Lime

As a consequence of the exacting requirements much study has been devoted to the properties of lime in their relation to the original limestone, to temperature and time of burning, effects of impurities, calcination equipment, and methods of hydration. Naturally, these two lines of inquiry, the development of specifications and the broader knowledge of the properties of lime, go hand in hand, for the one outlines the qualities desired for given uses and the other determines the methods of selection and manufacture that must be pursued to satisfy most fully the requirements of the consuming industries. A greatly increased knowledge has been gained of the physical and chemical properties of lime through the researches of the Bureau of Standards and the various fellowships established by the National Lime Association.

No problem has been more baffling than that of plasticity. Until recently little if any progress was made. Haslam and Hermann have recently found, however, that temperature and time of calcination had a definite effect on plasticity, and also that increase in plasticity accompanies increasing fineness of particle size. Marie Farnsworth, formerly of this station, conducted x-ray studies of lime plasticity at the Massachusetts Institute of Technology, and found that decreasing plasticity accompanied increasing percentages of either calcium hydrate or calcium carbonate in the quicklime from which the putty was made. That plasticity may be quite independent of chemical composition is apparent from the fact that limestones varying less than 1 per cent in their content of calcium and magnesium carbonates give limes of totally different plasticities. Thus some progress has been made toward unraveling the interwoven complexities of lime plasticity.

It is generally recognized today that physical as well as chemical properties of the original limestone may have a profound influence on behavior during calcination, on cost of manufacture, and on the use of the finished lime. Thus, porous limestones and coarsely crystallized limestones tend to break up greatly during the burning process. Porous limestones may contain water in quantities that demand an appreciable amount of heat for removal. Heat readily penetrates dense, non-porous stones, in consequence of which they may be calcined in a shorter period of time than the loose-textured or porous stones. This complexity of lime-burning is increased by the fact that limestones in no two deposits are exactly alike. Just as in a crowd of one thousand human beings no two faces are alike, so the stone of every deposit has its own individuality. Difference in grain size, in texture, in mode of crystallization, in hardness, in porosity, density, color, or impurities all have their influence in some degree, and thus a new limeburning enterprise is always experimental in its early stages.

It is well known also that the method of manufacture has a profound influence on the character of the lime produced. Lime manufacture in the rotary kiln is totally different from lime made of the same stone in a shaft kiln. It has been found that limestone calcined in a sintering machine in the short period of 30 to 40 minutes gives a lime which hydrates with extreme rapidity.

The inability of operators to calcine stone under 4 inches in size in the modern shaft kiln except in relatively small amounts has resulted in enormous waste of fine materials. During a visit by the writer to the Ohio district in 1925 it was estimated that within a radius of 30 miles of Toledo, the most productive lime district in the United States, there was a waste of approximately 4000 tons of small stone per day. This waste material is remarkably pure, averaging over 99 per cent of the combined carbonates of calcium and magnesium, its only fault being that it exists in sizes under 4-inch.

A realization of these heavy losses has inspired operators to make determined efforts toward better utilization of fine materials. The rotary kiln such as is used in cement plants is the most successful equipment for calcining small stone. The increased market for hydrated lime has encouraged its use, for the fine material produced in the rotary is best adapted for manufacture into hydrate.

Another factor that encourages the calcination of limestone fines is the gradual overcoming of the deep-rooted preference for lump lime. The prejudice against pulverized quicklime arises from two sources—(1) the tendency for impurities to be concentrated in the fines, and (2) the greater liability of air-slaking. The first of these objections is being met by improved quarry methods, particularly by cleaner separation of overburden and cavity-filling impurities. The second objection is being met by shipping quicklime in air-tight bags or drums. A pebble quicklime screened from the product of the rotary kiln is now being marketed successfully. The writer has recently observed that unscreened quicklime produced in the rotary kiln is being shipped in considerable quantities.

The Bureau of Mines has been studying this problem of utilization of fines for the past four years. About two years ago a series of tests was undertaken under the immediate direction of W. M. Myers, of the Nonmetallic Minerals Station, and R. W. Hyde, of the Dwight-Lloyd Sintering Machine Co., to determine an adaptation of the sintering machine to lime-burning. Briefly stated, it was found that the sintering machine could be adapted for successful calcination of spalls with fuel ratios comparable with present practice, and that the sintering machine possessed some decided advantages over present lime-burning equipment. The chief probable advantages are the ability to calcine fines, a comparatively low investment, ease of operation, little loss of time for repairs and replacements, and a low maintenance expense.

Tendency Toward Increased Fines

The point should be emphasized that the problem of utilizing spalls will probably become more urgent as time goes on. There are two pronounced tendencies in the lime industry, both of which lead to increased production of fines. The first is the tendency toward underground mining. Bench work in mines may possibly be conducted without any great increase in spall production, but assuredly the driving of tunnels into the solid face requires heavy blasting in closely spaced drill holes, with excessive shattering and the inevitable production of a high percentage of fines. The underground miner certainly loses the advantage held by many open-pit operators of reducing spall output by simply pushing out the rock with low-grade explosives in widely spaced holes. The second tendency toward increasing spall production is the employment of rock crushers. As pointed out previously, hand sledging is an effective means of keeping down the percentage of fines. Although the power breaker is at a disadvantage in this respect, advantages of the mechanical equipment in other respects are gradually leading to its wider use. A wider employment of the steam shovel and the power breaker seems inevitable, and human ingenuity will be directed toward overcoming their disadvantages. The power shovel is sadly deficient in its ability to select rock for quality, and this had been a strong point in favor of hand loading.

Thus it may be seen that the tendency in modern lime-rock production is toward increasing fines. How is this problem to be met—by the rotary kiln, by the sintering machine, by some other equipment, or by finding a wider and more profitable market than now exists for the uncalcined fines? Great improvements will no doubt be made in rotary kilns. Wide possibilities are also seen in the sintering machine. The writer is confident that the lime-producing industry will eventually solve this problem as it has many other problems. History is repeated in that the waste of today is the wealth of tomorrow, and may we not yet find through the evolution of equipment that the chips, spalls, and dust now regarded as waste will prove to be the forms best adapted for calcination?

Feldspar in Pacific Northwest

The present demand for feldspar in the States of Oregon, Washington and Idaho comes largely from the four manufacturers of architectural terra cotta who use feldspar in their glazes. The demand is only about five carloads per year and is met by the Atlantic coast producers of feldspar. In the last few years, good grades of potash feldspar near San Diego and Riverside, California, have been mined and ground in commercial quantities for the southern terra cotta and whiteware industries. South Dakota potash feldspar is ground in Murphysboro, Illinois, for the middle west trade. The demand for feldspar in the Pacific Northwest will increase when whiteware companies start operation in the local field. With a population of over 2,000,000 in the three States and the raw materials for whiteware at hand, it is possible that this development will begin in a short time.

A study of the eastern Washington and Idaho kaolins is being made by the United States Bureau of Mines in the ceramic laboratory of the University of Washington. It is important that the possible sources of feldspar and flint be considered in order to have the three components of a whiteware body. The flint can be most easily produced by grinding the purified quartz sand washed from the kaolins. With two exceptions all of the feldspar deposits thus far discovered in the Northwest are of the soda variety.

LIME IN THE PAPER INDUSTRY

By P. A. Paulson
Kimberly Clark Paper Company*

MANUFACTURE of paper dates back to the dawn of the Christian era. The exact date is not definitely known. Some claim it took place during the year 105 B. C.; others say it was not until the early part of the second century. The Chinese are given the credit for introducing paper-making and we are told that it was first made by one Ts'ai Lun from the bark of the mulberry tree, and that lime was used in the process. The Chinese soon learned to make paper from other material, chiefly linen and cotton rags and straw, and the secret of the process gradually became known all over the world. From China it was carried to Turkestan and Arabia, thence to Spain, Italy, France and Germany. But the progress was rather slow during the Middle Ages, and it was not until the seventeenth century that paper-making was established in England. The first paper mill in the United States was built in 1690.

Rags and straw and, to some extent, hemp, jute, manila, and esparto continued to furnish the raw material for paper-making until the latter part of the nineteenth century, when the increasing demand for paper led to the investigation of wood as the most abundant source of cellulose. Four different methods were evolved almost simultaneously for converting the fibrous substance of the wood into paper-making material. These are the ground-wood or mechanical process, and the soda, sulfate, and sulfite processes. The results from these inventions may be appreciated when it is stated that during 1926 there were manufactured in the United States 1,686,695 tons of newsprint, 1,380,000 tons of book paper, 3,650,000 tons of board, 1,450,000 tons of wrapping, 500,000 tons of fine, 295,000 tons of tissue, 1,038,305 tons of all other, making a total of 10,000,000 tons of paper in one year. Inasmuch as the purpose of this article is to discuss the use of lime in the paper industry, it will be confined to those processes where lime plays an important part.

In spite of modern inventions and discoveries in new paper-making materials, cotton and linen rags remain the outstanding material for quality paper, and in the United States the yearly output of paper made from rags is something like 500,000 tons. The equipment of an up-to-date paper mill making high-grade bond and writing paper from rags consists of rag cutters, dusters, boilers, washing engine, drainers, beaters, stuff chests, screens, and paper machines.

After the rags have been sorted to remove any non-paper-making rags, such as woolens, they are put through a machine resembling in principle a common lawn mower and cut into pieces of from 10 to 20 square inches in area. From the cutter they are carried on a belt conveyor to the dusters. There are many types of dusters; one type, known as the "railroad duster," consists of a series of drums having pins or teeth arranged helically around the surface. As they are made to revolve, the rags are passed from drum to drum over a fine screen.

The boiling process usually takes place in spherical boilers having a capacity of about 5,000 pounds. The object of boiling is to saponify the grease, to dissolve dirt and impurities so that they may be easily washed out, to destroy any wool which was not removed during sorting, and to change the coloring matters so that they may be easily bleached. The chemicals used are lime, caustic soda, or a mixture of lime and soda ash, choice being largely one of personal preference. Lime is only slightly soluble in water and the boiling process will therefore take longer than when caustic soda, which is readily soluble, is used. However, when the dissolved portion of the lime is used up, a fresh portion dissolves, so that the solution remains practically at a constant strength throughout the boiling. Moreover, the slight solubility of the lime prevents injury to the fiber, resulting in higher yield. The color of the fibers cooked with lime is much whiter and more permanent than when cooked with caustic soda. The quantity of lime used is about 375 pounds for 5,000 pounds of rags. The cooking time is usually about 12 hours at 30 pounds pressure.

When the boiling is completed the pressure is reduced, the liquor drained off, and the pulp dumped into the washing engine, where the dissolved impurities are thoroughly removed. When white paper is to be made the bleaching agent is added and when the desired color is obtained the pulp is again washed to remove any excess bleach and the products of the bleaching process. It is then dumped into drainers, where it remains for several weeks before being taken to the beaters.

The beaters separate the fibers in the pulp or "half stock," which it is now called. Here also the loading and sizing materials are added. The loading or filling is necessary in order to produce the many different grades of paper demanded by modern printing practice. It fills the pores between the fibers and makes the smooth surface desired where cuts are used. It also makes the paper opaque and enables it to take a better finish on

*Presented before the Symposium on Lime at Richmond, April 13, 1927.

calendering. The materials used as fillers are China clay, talc, and calcium sulfate in its various forms. The capillary action of the fibers and the spaces between them makes the paper absorbent. In order to make it non-absorbent, which is desired in writing paper, the fibers must be coated with some substance that will resist the passage of the ink. This is accomplished by adding some sizing material such as sodium resinate, starch, casein, or animal glue. To make colored paper the required color is also added to the pulp in the beater. The pulp is then ready for the paper machine and is dumped into a chest usually located directly below the beater.

The modern paper machine differs but little from that originally constructed by Fourdrinier. It consists essentially of an endless mold of wire cloth, unto which the prepared mixture of fibers flows and is converted into a continuous web of paper, which then passes under and through a series of rollers and over a number of heated cylinders where it is completely dried. The most outstanding features of a modern paper machine are its enormous size and capacity; the latest types will produce a sheet of paper 22 feet in width and at a speed of 1,200 feet per minute, and will turn out 125 tons in 24 hours.

The processes for changing wood into paper-making fibers are entirely different from that used in the treatment of rags. The trees are felled in the forest, the limbs trimmed off and the trees cut into 8 or 16 foot lengths. These are taken to the mill and again cut into suitable lengths of from 2 to 4 feet. The bark is then removed and the blocks of wood are taken to the chipper, where they are cut up into chips about 5/8 inch in length. The chips are stored in bins located directly above the boilers or digesters.

Soda Process

Where the soda process is used, the digesters are plain cylindrical steel vessels with conical tops and bottoms, having a capacity of 15 cords of wood. The digesters are filled with chips and the cooking liquor is added. This consists of a caustic soda solution of about 10° to 12° Bè. at 60 degrees Fahr. After the cooking is completed the mixture of pulp and liquor is discharged into the blowpit and thence into washing tanks, where the pulp is washed and drained to free it from the colored liquor. The washed pulp is screened and bleached and is then ready for the beater, where it will undergo practically the same treatment given the pulp from rags.

The black liquor from the washing tanks is put through evaporators and thickened to about 35° Bè. and then through rotary furnaces to remove the organic substances in solution. The product is called black ash and contains about 80 per cent soda ash. This black ash is leached to dissolve the soda ash, which in turn is pumped to the causticizing tanks, where fresh soda ash is added to make up for the losses, and the whole is then boiled together with lime in order to change the sodium carbonate to caustic soda according to the formula:

$$Ca(OH)_2 + Na_2CO_3 = 2NaOH + CaCO_3$$

The caustic soda is then ready for another digester of chips to be cooked. There are being manufactured yearly in the United States about 500,000 tons of soda pulp and the consumption of lime is from 600 to 650 pounds per ton of pulp produced.

Sulfate Process

This process differs from the soda process only in that salt cake (sodium sulfate) is used to make up the losses instead of soda ash. This process is employed to produce a specially strong pulp known as kraft, and is used for making high-grade wrapping papers. Lime is used for causticizing the cooking liquor and the same quantity per ton of pulp is required as in the soda process. About 460,000 tons are being manufactured yearly in the United States.

Sulfite Process

This process differs from the soda and sulfate processes in that it is an acid instead of alkali process. It is best adapted to use for cooking spruce, balsam, and hemlock wood. It has a mild action on the incrusting matter, produces a white, clean fiber, and a much higher yield is obtained than with any other chemical process. It is the most commonly used of the chemical processes, there being something like 1,500,000 tons produced yearly in the United States. The amount of lime (CaO) required for a ton of this pulp is approximately 175 pounds.

There are two methods of preparing the cooking liquor—one known as the tower system, the other the milk of lime system. In the tower system sulfur dioxide gases, which are obtained by burning sulfur, are made to pass through high towers filled with limestone. The gases enter the bottom of the tower and ascend while a spray of water at the top of the tower descends. When the water reaches the bottom of the tower, it has absorbed all the gases and part of the lime rock. The sulfur dioxide has combined with water and lime to form calcium bisulfite and the solution will contain approximately 1.5 per cent combined sulfur dioxide and 2.5 per cent free.

In the tower system pure calcium carbonate must be used, because if dolomite or limestone containing a large percentage of magnesium carbonate is used the magnesium carbonate will separate out in the form of sand and clog the apparatus. In the milk of lime system the sulfur dioxide gases are made to pass into a solution of calcium hydroxide. The apparatus is usually a vertical cylindrical tank divided into several compartments. The limewater enters the upper compartment and overflows from one compartment to the other. The gases enter the lower compartment and ascend to the several compartments. With this equipment, lime containing any amount of magnesium can be used. The question of which method to use is largely one of personal preference. Out of seventy-three mills, only twenty-eight are using the milk of lime system.

Amount of Lime Used Annually in the Paper Industry

	Tons
Boiling rags, aproximately only	18,750
Causticizing in soda mills	162,500
Causticizing in sulfate mills	150,000
Acid-making in sudfate mills	50,300
Total	381,550

Cooperation Between Lime and Paper Makers

It can easily be seen that there are possibilities for increasing the use of lime in the paper industry, and to realize them a closer contact between the manufacturer of lime and the paper maker is needed. The lime manufacturer should study paper-making so that he may be in a position to offer suggestions in matters that have to do with the chemicals used. In the paper industry the salesmen know more about the printing process than they do about paper-making. When any difficulties arise they are there to help solve them and to pass the information along to the paper mills, so that the changes can be made to bring about the desired results. In the writer's twenty-five or more years' experience in the paper industry he has not yet come into personal contact with any of the men who manufacture the lime he uses; all the business is done by correspondence.

In the manufacture of sulfate pulp it is an established fact that pulp cooked with a mixture of calcium and magnesium bisulfite is of much better quality than that cooked with pure calcium bisulfite; the fibers are softer, whiter, and more easily bleached, and the yield is considerably greater. Yet a large number of the mills are using the tower system for preparing the acid. The same is true to a lesser degree in the rag-boiling process. Cooperation would not only promote the welfare of the paper and lime industries, but it would tend to conserve our natural resources and prevent a shortage of paper.

Extensive research work is being conducted in the paper industry, but it is chiefly with a view of obtaining a larger production—wider sheets of paper and higher speed. The choice as to what chemicals to use for resolving the raw material into paper-making fibers is arbitrary. When a new mill is built and the question as to what type of acid-making equipment to install arises, someone will advise putting in the tower system because limestone is cheaper than burned lime, not realizing that limestone weighs twice as much as lime and when the material has to be transported at some distance the freight costs as much as the limestone and the cost of handling is likewise higher. It is not very often considered that because magnesia is a stronger base the cooking process can be continued to its absolute completion without injury to the fibers, thereby reducing the amount of rejections or screenings and consequently increasing the yield.

It has been argued that the Europeans use the tower system. This is true, but there is no dolomite in Europe. At a recent meeting of the Verein der Zellstoffe und Papier the question as to the best cooking liquor to use in sulfite mills was brought up, and Professor Schalb stated that he was well aware that magnesium bisulfite was the best. "But," said he, "what are we Germans going to do? We have no magnesium." The paper manufacturer seems to be too busy to keep up with the ever increasing demand for paper to give this matter careful thought and study. There is a need for someone to arouse his interest and bring about a desire and decision to give this problem the attention it merits.

There is need of our combined effort to perpetuate the forest. At the present rate of consumption of wood for paper and other purposes, it will be only a matter of a few years until the forests are depleted unless steps are taken to prevent it. This is well-known but not seriously considered. In some European countries federal laws have been in force more than fifty years making it compulsory to plant two trees for every one that is cut down, and they have abundant supply to meet all their demands. What we need is public sentiment to bear on our legislators to enact similar laws, and we can all help.

No other single commodity has done so much for the advancement of civilization, education and comfort of mankind as has paper. By conserving our raw materials through the adoption of the most economical methods for resolving them into paper-making fibers and by perpetuating the growth of the forest, we shall be able to enjoy these blessings for years to come and incidentally promote the prosperity of the lime and paper industries. To this end the manufacturers of lime can render a great deal of assistance.

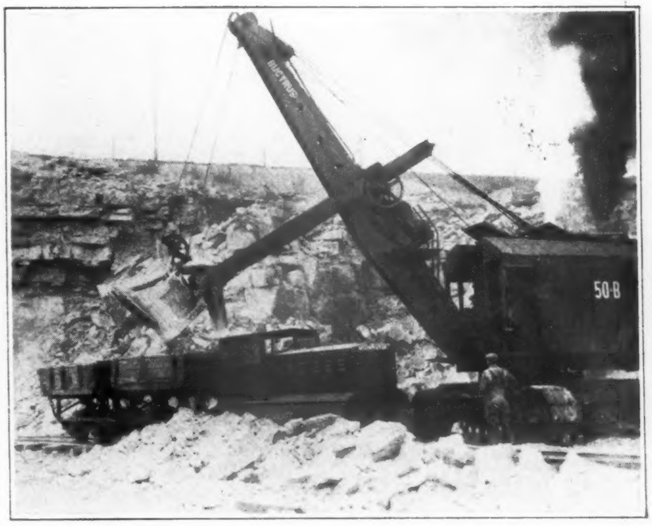
Surfacing Tennis Courts

A surface for tennis courts is made from a mass produced from 25 per cent fine brick powder, 20 per cent coarse brick powder, 15 per cent sand, 20 per cent green coloring matter, 10 per cent black lime, 5 per cent cement and 5 per cent Whiting. Viehsally (British Patent).

REBUILDING PLANT ECONOMIES ILLUSTRATED BY WAUKESHA LIME AND STONE COMPANY

By E. D. Roberts

DURING the past year or two the managers of the Waukesha Lime and Stone Company, Inc., have been making many changes in the methods and equipment used in their two plants which were started in 1905 and 1909 respectively. These changes have been made somewhat gradually: the installation of machines different in design from those then in use; improved methods, and finally the substitution of standard gauge Milwaukee gasoline locomotives, each hauling seven yard Continental cars. The last addition replaced an old steam locomotive which was used to move four yard cars. These improvements enable this company to compare favorably with the new plants of today when smoothness of operation, efficiency, and flexibility are used as a basis for comparison.



Loading Stone in Quarry

Some of the outstanding features among the installations made at the plants during the past year are Allis-Chalmers Newhouse crushers; the 80-B Bucyrus steam shovel with its extra long reach and the standard gauge pit tracks with automatic switches over which three 16 ton Milwaukee gasoline locomotives haul the trains of 7 yard side dump Continental cars.

The plants are located on both banks of the Fox River and on the tracks of the Soo Line and the Chicago, Milwaukee and St. Paul Railway, a mile and a half north of the city of Waukesha. This city has been made famous nationally, due to the wonderful mineral springs which are located within its limits and from which such mineral waters as Roxo, White Rock and others are drawn, bottled and shipped throughout the United States. At


Excellent View of the Quarry Layout

View of Sand Pit

Waukesha, a connection is made with the Chicago and Northwestern Railroad, thus giving two routes over which to ship to Milwaukee, which is located 15 miles due east of Waukesha. These three railroads, together with a concrete highway which runs through the property of the company, provide a ready means of access to such markets as Milwaukee, Janesville, Beloit, Stevens Point and other growing industrial centers, within a shipping radius of Waukesha. Two of the by-products of the company, agstone and asphalt filler, are shipped to all points within the state of Wisconsin and also to nearby territory in the surrounding states.

During the glacial period, Wisconsin was overrun with a large ice sheet or glacier which melted and deposited sand, gravel and boulders which it had broken loose from the bed rock of the countries to the north. Some of these deposits are composed of fine sand, others of coarse sand and gravel and others of boulders, depending upon conditions existing at the time of melting and whether or not the deposit had been rewashed by rivers since the retreat of the glacier. As Wisconsin is largely level, this rewashing has resulted in the formation of numerous lakes, in the beds of which the fine material was deposited. However, this fine material is objectionable for use as a concrete sand and it is rare that a deposit of such magnitude as that owned by the Waukesha Lime and Stone Company is found which produces such excellent concrete aggregates.

Nature has seemingly endowed Waukesha with wonderful natural resources and made possible the wonderful deposits of the Waukesha Lime and Stone Company, forming the large deposit of sand and gravel in addition to sweeping bare, with the

Loading in the Sand and Gravel Pit. Note High Bank.

waters of the Fox River, a portion of the underlying high magnesium limestone bed rock. It was in this limestone formation that the company originally started operations in 1905. In this deposit two large areas have been worked to a depth of fifty feet, one of which is now being used as a settling basin for tailings from the washing plant. Production is now being maintained from the northern quarry, which is located on the west bank of the river. The sand and gravel plant is producing washed and screened, graded sand and gravel from the deposits on the east bank of the river. Here a working face of 110 feet is maintained for a length of three quarters of a mile. The operation of excavating the sand and gravel is also stripping more of the valuable limestone bed rock which lies above the surface of the Fox river.

In addition to sustaining a strong sales campaign for its sand and gravel, the company is a member of the Wisconsin Agstone Association, through which the sales of this rock fertilizer are made. The company is also contributing to the increased use of agstone, as a land conditioner, by the educational campaign being carried on by the Association, being one of its principal members.

On an average, about 4 feet of earth has to be removed in order to lay bare the limestone. This stripping is done from time to time on a contract basis so as not to interfere with the regular operations of the quarry. The limestone lies in horizontal bedding planes, showing that very little folding has taken place in the earth's surface since it was laid down by the accumulation of fossils in the bed of prehistoric Lake Niagara, from which it received

Method of Loading Material

Close-Up View of the Initial Crusher

Close-Up of Well Drill

its name of Niagara Limestone. Vertical drill holes, 6 inch in diameter and 18 feet centers, are placed by a Sanderson Cyclone electric well drill. A number of holes are exploded at once after loading with 5 x 16 Du Pont dynamite. The rock breaks up well with but few large boulders. These are broken up by small charges of powder after holes have been made by Ingersoll-Rand jackhammer drills.

A 50-B Bucyrus steam shovel, equipped with caterpillar traction and an extra long dipper stick and boom, loads the broken rock into 4 yard Western side dump cars. These are moved by a 36 inch gauge Milwaukee gasoline locomotive to the crusher. The cars dump directly into the Allis-Chalmers 44 inch x 60 inch jaw crusher. As the crushed rock, now no larger than 8 inches, comes from the jaws of the crusher it falls into the pans of an Allis-Chalmers inclined continuous conveyor. This elevates the material to the top of the crusher building and there discharges into a 60 inch diameter by 12 foot scalping screen. Material failing to pass through the 2 inch perforations in the screen is discharged into a number 7½ Allis-Chalmers gyratory crusher for further reduction. Another scalping screen, placed so that it receives the discharge from this crusher, rejects all pieces over 2 inches to Power & Mining Machinery Company rolls which are set with 2 inches opening. The product of the rolls, as well as the material passing each of the scalping screens, is led by chutes into an inclined 28 inch bucket elevator which carries it to the top of the crusher building for a second time.

An O'Laughlin screen made of concentric sections, 46 inch x 12 feet, 58 inch x 9 feet 6 inch, and 66 in x 9 feet, receives the discharge from the elevator head and sizes it to the main stone sizes, rejecting the oversize to a number 5 high speed Allis-Chalmers reduction crusher. Each grade as produced by the screen falls through a chute leading to the bin for that size of material.

A large proportion of the rock from 3/16 to 1½ inch is taken by an "Amesite" plant which is located near the company's property. There is also a ready market for the remainder of this material throughout the territory close to the plant. Material that is too small for concrete purposes is discharged on an endless steel belt, 16 inches in width, with 270 foot centers, which carries the fines through a gallery into the by-products plant, located directly south of the crusher buildings.

Quarry View Showing the Character of Rock

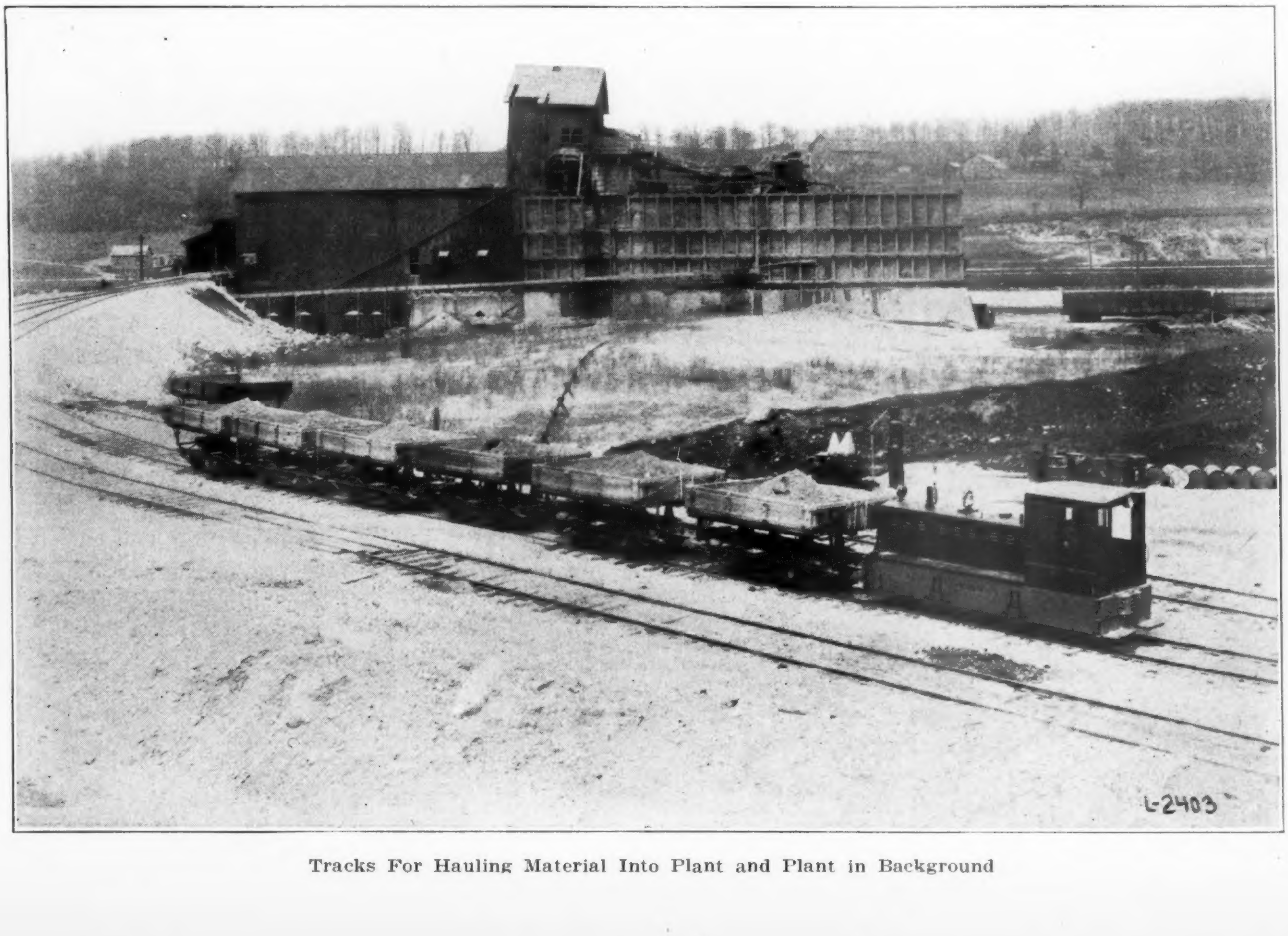
The By-Products Plant

This by-products plant converts the fine material produced in crushing the stone, and which has no great value for concrete purposes, into manufactured articles for which a demand exists, thus converting a possible loss into a profit. Its main products are agricultural limestone, asphalt filler, terrazo stone and chicken grits, the last two being produced in several sizes.

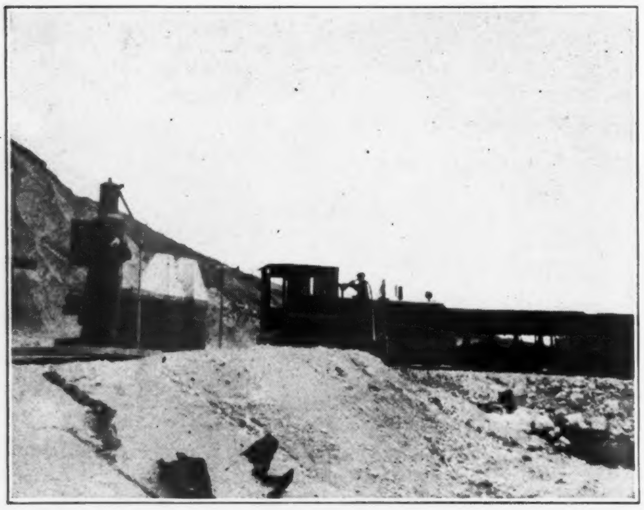
The steel belt, which brings the fine material from the crusher plant, discharges its load directly into an Allis-Chalmers dryer, 60 inches in diameter by 52 feet long. This dryer discharges the dried limestone on to a short belt conveyor which passes the material over a Dings magnetic pulley in order that any tramp iron or other metallic substances be removed from the feed. The short belt discharges into two number 2 Allis-Chalmers pulverizers. A vertical bucket elevator receives the ground material as it comes from the pulverizers and carries it to the top of the building where it is led to two Hummer screens. By changing the screens in the Hummers, any desired grade of product can be obtained. The oversize from the screens is chuted back into the pulverizers for further reduction.

During the winter months, while Agstone is being produced in quantity, number 10 mesh screens are used to produce the desired grade of limestone fertilizer. This product, ranging in size from dust to one tenth of an inch, so that its effectiveness will last over several years after one application, is sacked and sold to the trade as agricultural limestone. With the approach of spring, which is a slack season for the Agstone trade, production is turned to dust for use as an asphalt filler, thereby keeping the production of the plant at normal for the balance of the year. The screened material from the Hummers is led to a 60 inch by 22 foot Schmidt tube mill which reduces the fine particles

Inside View Showing Magnetic Pulley



Tracks For Hauling Material Into Plant and Plant in Background



Locomotive Loading Up With Gas

so that they will pass a screen having 200 openings per inch. A bucket elevator receives the discharge from the tube mill and discharges it into a bin, located over and feeding into a 2 valve Bates valve packer, which blows the powdered material into the sacks.

A large storage warehouse is provided at the southern end of the by-products plant to properly care for the storage of finished products awaiting shipment as well as for the empty sacks.

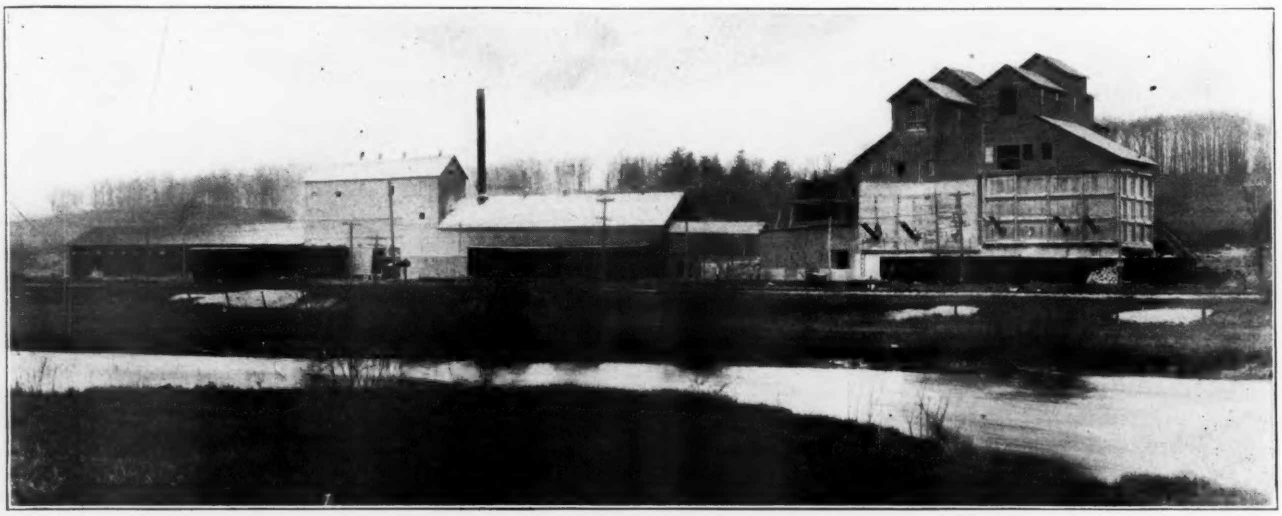
Both the crushed stone plant and the by-products plant are located upon a siding of the Soo Railroad, which here parallels the concrete state highway, previously mentioned. The crushed stone bins are built directly over a track, so that the rock can be drawn off into the cars by gravity. A tunnel under the bins provides a means for gravity loading of trucks so that cars can be loaded when placed on another track, which runs alongside of the bins. Gates placed in the side of the bins, feeding into metal chutes, provide for the proper loading of these cars without hand labor or waste of material. Individual electric drives are used to operate the various units throughout the crusher plant as well as the by-products plant. One of these motors is a 200 horse power Allis-Chalmers unit which operates the 44 inch by 60 inch jaw crusher.

Sand and Gravel Plant

As stated before, the face of the gravel pit extends for over three-quarters of a mile in length and to a height of 110 feet. This wonderful face is the result of careful development during the past years. The gravel is overlaid with from 5 to 6 feet of earthy material which is removed under contract. At the present time a contractor is removing the overburden from about 50,000 square feet of the gravel. A P & H number 206 gasoline shovel, operating on caterpillar treads, is excavating the earth and loading it into 1½ yard Western dump cars which are handled, in trains of ten cars each, by a Whitcomb locomotive to the dump. This dump is located at the south end of the pit face, which at this point cannot be extended farther, due to the proximity of the state highway, thus providing an excellent place for disposal of the strippings at small cost.

The high gravel bank calls for special handling which is provided for by the 80-B Bucyrus steam shovel with its 52 foot boom and 33 foot dipper handles. With this long reach, a cut 80 feet in width can be made or, with a narrower width, the shovel is able to rake down the bank and also guard against land slides. Seven yard side dump Continental cars receive the gravel from the steam shovel and are handled in trains of three each by 16 ton standard gauge Milwaukee gasoline locomotives. Three of these locomotives, one at the shovel, one at the plant and the other on the road, serve to keep the plant operating at full capacity.

The noiseless operation, together with the tractive power of the locomotives, caused the writer to investigate more closely these vehicles. It was found that air cleaners, electric lights, starters and numerous other accessories, now deemed necessities on pleasure automobiles, have been installed on



View of the Main Plant

these machines to make for easier and good operation of this commercial unit. Four speeds ahead and reverse—2, 4, 8, and 12 miles per hour—provide for flexibility of operation; a governor is provided so that the engine can not be injured through racing of the engine; and Westinghouse direct air brakes insure the split hair spotting required of tractive units in pit and quarry haulage. The operators of the plant are so pleased with these locomotives that they doubled the train of 7 yard Continental cars and pushed this train of 6 cars up a 5 per cent grade and around a sharp curve as a demonstration of their tractive power.

The trains enter the plant on a high trestle which runs alongside the receiving crusher. Here the cars are side dumped into an open hopper, the bottom of which is a pan conveyor operating on an upgrade. This pan conveyor feeds the material to the number 12 Allis-Chalmers gyratory crusher at an even rate, flooding being prevented by the incline given to the feeder.

After passing through the number 12 gyratory crusher, the gravel falls into an inclined bucket elevator, equipped with 36 inch buckets operating on 40 foot centers. This bucket elevator discharges into a scalping screen 60 inches in diameter and 12 feet long. All material over two inches in size is rejected by the screen and discharged into a dividing stone box from which it is drawn into four reduction crushers. The two crushers on the right of the box are regular number 6 Allis-Chalmers gyratory crushers and those on the left are the new Newhouse speed reduction crushers also manufactured by the Allis-Chalmers Company.

All four of the crushers, as well as the fines from the scalping screen, are directed into an inclined bucket elevator leading to the sizing screen located in the top of the structure. Three O'Laughlin screens with triple concentric shells, similar to those previously mentioned, grade the material, producing three grades of concrete gravel, number 2, number 3, number 4, and three grades of common gravel, number 1, number 2, and number 3. As the material enters the screens, water is played on it from pipes placed within the screens. Nearly 5000 gallons of water per minute is furnished by three Allis-Chalmers centrifugal pumps to thoroughly wash the material and carry off the sand and silt in a flume to three 72 inch Dull separators. These remove the concrete sand from the water and allow the water to carry the silt and lighter particles off in a flume to the settling basin.

Each grade of concrete gravel and common gravel, as well as the sand, falls directly into its proper bin, placed below the screens. These bins have a large capacity and all of them can be drawn off by gravity into cars, spotted on tracks running underneath the bins. Gates in the side of the bins allow the material to be drawn off through chutes into motor trucks. A fleet of trucks are used to haul the sand and gravel and the crushed stone from the bins. These trucks are equipped with the latest type of Heil dump body and after being filled at the bins are required to pass over a Fairbanks-Morse twenty ton truck scale which is located outside the plant office.

As is necessary in other plants where a peak demand is experienced, the Waukesha Lime and Stone Company stores considerable material in outside piles. The excess material is drawn off into cars which are spotted alongside the storage piles. A 20-B Bucyrus shovel crane, operating on a caterpillar tread, runs along between the track and the pile and unloads each of the cars by means of a clamshell bucket. When shipping from storage, the opposite operation is followed. Most of the men working at the plants live in the 33 houses which have been provided by the company, the rest of the men living in Waukesha.

Mr. M. O'Laughlin Gillen is president and treasurer of the company, Mr. E. E. Gillen is vice-president, Mr. H. M. Halverson is manager and secretary, Mr. F. C. Wolf is general superintendent, Mr. N. K. Wilson is sales manager, and Mr. E. F. Bremer is office manager. The principal office of the Waukesha Lime and Stone Company is maintained on the company's property and an office is also maintained in Milwaukee at 3002 Plankington Building.

Welding Society Announces The Miller Medal

At the annual dinner of the American Welding Society held in New York on April 28th, President F. M. Farmer announced the donation of an award, the gift of Samuel Wylie Miller, to be presented by the Society annually in appreciation of work of outstanding merit in advancing the art and science of welding. The award is a gold medal, which will be known as the Miller Medal.

Mr. S. W. Miller has been one of the outstanding figures in the advancement of welding ever since its commercial inception. He is a past president of the American Welding Society, and a prominent and active member of the Society of Mechanical Engineers, American Institute of Mining and Metallurgical Engineers and other scientific and engineering organizations. Mr. Miller is Consulting Engineer, Union Carbide and Carbon Research Laboratories, Inc.

In establishing this award, the details for the administration of which are not yet decided upon, Mr. Miller's object is to promote an appreciation of better welding and to encourage the study of those fundamentals which will lead to raising the quality of work done by the average operator.

USE OF LIME IN BUTTER MAKING

By O. R. Overman*

NEW methods of handling and transporting cream, developed since the latter part of the nineteenth century, have led gradually to a change from the smaller creamery in the predominantly dairy sections of the country, where the cream was hauled directly from the farm to the creamery by the farmer himself, to the centralized creamery which depends upon cream shipped for many miles to the central plant.

These changes in the industry introduced new problems of both economic and scientific importance. The purpose of this paper is to show how one of the most troublesome of these problems, the presence of a high percentage of acidity in cream, has been met by the maker of butter and by the investigator in dairy science, some of the attempts which have been made to solve it, and the present status of the problem.

The growth of the centralized manufacture of butter led gradually to a reaching out to greater and still greater distances in order that an adequate supply of the raw product—cream—might be procured. It also involved the extension of the field to the general farmer, who kept a few cows and produced individually a small amount of cream but collectively an astonishingly large amount. It is estimated that 80 to 85 per cent of our butter is made from cream produced on such farms. Because of the small amount of cream produced individually on these farms, and the cost of making deliveries, there was some delay in reaching the manufacturer. The result was that much of the cream was sour, some of it very sour, on its arrival at the plant. It was soon learned that butter made from cream high in acidity, even though of satisfactory quality and pleasant flavor when made, showed a tendency to develop an unpleasant flavor when stored. It was also known that cream must be pasteurized if butter of the best keeping quality was to be made from it, and the Dairy Division of the United States Department of Agriculture had shown that butter from cream with low acidity kept better in storage than butter from cream with high acidity. Attempts to pasteurize cream of high acidity resulted in the coagulation of the casein, causing the cream to become stringy or ropy. A portion of the butter fat became entrapped in the coagulum and when such cream was churned there was a loss at times of 1 to 2 per cent of fat in the buttermilk.

All these factors led to the search for a way by which the acidity of the cream might be safely and satisfactorily reduced previous to pasteurization. The outcome of this search was the process known as "neutralization." The first reference to the practice seems to be that of Flint, in 1869, who says, "It is a perfectly harmless addition and increases the product of the butter and improves the quality." Babcock and Russell in 1896 described the use of viscogen to restore the viscosity of pasteurized cream for table use, and one creamery is known to have used viscogen at an early date to reduce the acidity of sour cream. McKay and Larsen state that as far back as 1901-2 one of the authors conducted extensive experiments on the use of alkalies of various kinds for reducing the acidity of cream for butter-making. Some butter-manufacturing firms as early as 1905 used a lime preparation in the commercial manufacture of butter. Since then the practice has gradually grown until now it is very general.

Many studies have been made of the neutralization of the acidity of cream by the use of different alkaline substances. The objective of these researches has been the discovery of a neutralizing substance which would (1) reduce the acidity of the cream in such a manner as to allow efficient pasteurization, (2) reduce the butter-fat losses in the buttermilk, (3) improve the keeping quality of the butter, and (4) be free from serious objection by officials charged with the enforcement of laws concerning food adulteration and the public health. Hunziker says, "Improvement of the flavor of butter from tainted cream, or the removal of rancidity by neutralization, is not possible, notwithstanding many claims to the contrary. These facts have been conclusively established."

The most important of the alkaline substances which have been used are sodium carbonate, sodium bicarbonate, sal soda, calcium carbonate, calcium oxide, calcium hydroxide, magnesium oxide, and magnesium hydroxide. The tendency in the United States has been to favor the use of the calcium or magnesium limes, while the British Empire uses chiefly the sodium compounds. Quicklime was the first of the lime neutralizers to be used in the United States. However, because of the lack of uniformity in the product and because of the care and labor needed to prepare milk of lime from commercial quicklime, dry hydrated lime has, in the past few years, almost wholly replaced quicklime.

In any case, when cream is to be neutralized for butter manufacture, certain standards and methods must be adhered to:

1. The cream must have a definite minimum acid content after neutralization.

2. The acid content of the cream must be accurately determined.

3. The correct amount of the right kind of neu-

*Presented before the Symposium on Lime, Richmond, Virginia, April 13, 1927.

tralizer must be used to reduce the acid content of the cream to the desired minimum.

4. The neutralizer must be added to the cream in such a way as to accomplish the best results.

It is necessary to decide first to what extent neutralization shall be done. Hunziker and others have shown that the most satisfactory results are not secured unless the acidity of the cream is reduced to about 0.3 per cent and also that neutralization must not be carried much below 0.2 per cent acidity. In order to control the amount of neutralization, accurate determinations of acidity must be made. These are made by titration of the cream with 0.1 N sodium hydroxide, using phenolphthalein as indicator.

Each of the neutralizers which have been used has certain advantages and certain disadvantages. Calcium carbonate is not used because of its slight solubility and consequent slowness of reaction with the acid. Sodium carbonate and bicarbonate, being readily soluble, are very convenient to use. The carbonates react with the acid of sour cream to form carbon dioxide. Some investigators and creamery operators have claimed that the escape of the carbon dioxide during pasteurization removes undesirable flavors and odors from the cream. This contention does not seem to be substantiated. Sodium hydroxide, because of its strong caustic properties, has not been found satisfactory. Hydrated lime is thought by many creamery operators to be the most satisfactory alkali. Hunziker, in discussing the relative merits of different neutralizers, says:

"The flavor of the butter made from cream neutralized with soda lye, sodium carbonate, or sodium bicarbonate is prone to have a soapy character. This is especially true of cream of high original acidity and cream in which the acid is reduced very close to the neutral point. With lime hydrate, properly prepared and intelligently used, and using a sufficient quantity only to reduce the acidity to 0.25 per cent or thereabout, no objectionable flavor effects occur."

However, if very sour cream is neutralized with lime, a limy flavor is likely to appear in the butter unless the neutralization is very carefully done, especially if the cream is over-neutralized. Some creamery operators reduce the acidity to 0.35 to 0.4 per cent with lime, and finish the neutralization to the desired acidity with sodium carbonate or bicarbonate, and obtain satisfactory results.

Hydrated lime is used in suspension in water. The suspension is made of convenient strength—for example, 2 pounds of hydrated lime in 1 gallon of the suspension. The use of this suspension depends upon the fact that as the molecular weight of the dibasic hydrated lime is 74 and the monobasic lactic acid is 90, 37 pounds of dry hydrated lime will neutralize 90 pounds of lactic acid. That is, for the neutralization of 0.01 per cent of lactic acid in 100 pounds of cream, 0.00411 pounds of hydrated lime, or 0.01644 pint of the mix of the strength indicated above will be required. However, it has been shown by Hunziker and his coworkers that when a lime mix is used for the reduction of the acidity in cream, a portion of the lime, ranging usually from 16 to 20 per cent, does not react with the lactic acid. They explain this fact as follows:

Casein is present in fresh sweet cream as a calcium salt. Some of the lactic acid formed during the souring of the cream reacts with the calcium caseinate, forming free casein, casein lactate and calcium lactate. On the addition of lime the acidity of the cream is reduced. This condition favors the combination of a portion of the calcium with the free casein and the reformation of calcium caseinate. In verification of this explanation they have shown that while the serum of the neutralized cream contained 51 per cent more calcium than the serum of the same cream before neutralization, the curd of that cream contained 285.7 per cent more calcium after neutralization than it did before.

The reduction in the neutralizing strength of the lime mix may be compensated for in one of two ways: (1) About 20 per cent more dry hydrated lime is used in the mix, or instead of the 2 pounds per gallon of mix required theoretically for the reduction indicated above, the actual proportions are 2.4 pounds of lime in one gallon of the mix. (2) A lime with about 20 per cent greater neutralizing strength than pure, dry hydrated calcium lime is selected. Such limes are the magnesium limes containing 35 to 50 per cent of magnesium oxide. They have on the average from 16 to 20 per cent greater neutralizing strength than an equal weight of the pure calcium lime. If such lime is used the mix may be made as originally indicated—2 pounds of the magnesium lime in 1 gallon of the mix.

Numerous experiments under practical factory conditions have shown that either of these two mixes will give satisfactory reduction of the acidity of sour cream. Some creamery operators use pure calcium lime. Others use magnesium lime. Each group claims that better results are obtained with the type of lime it is using than with that used by the other group. Thus the relative merits of the two types of lime for the purpose under consideration are open for further study.

After the proper amount of lime to be added to a given vat of cream is known, the method of addition must be carefully controlled. The lime mix, if of the strength given above, is thoroughly stirred to render it as nearly homogeneous as possible, strained to remove lumps, and diluted with an equal volume of water. The diluted lime mix is added to the cream, which must be vigorously agitated all the while, in the form of a fine spray distributed over the surface of the cream.

The use of alkaline substances for the purpose of reducing the acidity of sour cream which was to be used for butter-making was at first opposed by public health and food inspection officials. The objections seemed to be based largely on the mistaken ideas that the purpose of neutralization was to make possible the use of a product unfit for food in the manufacture of a food, and that the alkaline substances used should be considered as food adulterants. With the growth of a better understanding of the real purposes of neutralization these objections have largely disappeared. The development of the practice of neutralization has made possible the profitable manufacture of millions of pounds of butter, and—a fact which is of especial importance during the present agricultural depression—has assisted in providing a stabilized market at fair prices for a farm product which is important in all sections of our country.

Stability of Asphalt Paving Mixtures

Lake Michigan has been the source of at least 90 per cent of the sand entering sheet asphalt pavements laid by the City of Chicago, and while this sand ordinarily runs good, still there are times when it causes rejection because it does not pass grading as set forth in the specifications. It seems that the storms on the lake have a decided influence on the character of the sand taken from any particular spot in the lake.

In order to improve the technique of the asphalt mixes when using this kind of sand and to test out new sources of supply the city was prevailed upon to obtain the necessary apparatus to run stability tests soon after Hubbard published his first paper on the subject. The problem here is to so modify our mix containing sand or other aggregate that we can keep our three asphalt plants going continuously without interruption.

The question of sharpness of mineral aggregate has always been shrouded in mystery, being condemned by some, favored by others and not mentioned at all by most writers. This last was a most natural attitude to take, for no facilities were available to study this effect until the various forms of testing apparatus had been designed. Bearing this in mind, it was decided to give this detail of asphalt pavement mixtures more careful study than has heretofore been given to it. In order to make results applicable to the needs as a city this study is restricted to types of material that could be obtained in Chicago without too much difficulty. The method used in making the tests was the same as Hubbard's modified method as given before the A. S. T. M. in 1926 with the following exceptions:

An Olsen 20,000-pound hand-driven compression machine with a 5,000-pound indicating device was used instead of the machine used by Hubbard. The indicating device consists of a 4½-pound dial spring scale that has been carefully calibrated by the manufacturer on the same type of compression machine as furnished, to read in increments of 25 pounds to 5,000 pounds. In running the compression machine to make the briquette the gear is turned at the uniform rate of a turn a second, which lowers the head at the rate of 0.0312 in., and in extruding the briquette the load is applied at the rate of one revolution per second on the counter shaft or 0.0052 in. at the head.

Instead of storing the prepared briquettes in the room at ordinary temperatures it was found better to store samples in an air bath at a temperature maintained constantly from 75 to 79 degrees Fahr. When comparing tests made in winter with tests made in summer of the same asphalt mixes there is a chance for variation in stabilities due to the difference in air temperatures at those times, the room temperatures varying 50 degrees. All this air bath consists of is a copper container with a hand hole and cover, inserted in a home-made electric constant temperature bath.

Instead of heating the samples directly on machine at 60 degrees Cent. according to Hubbard's methods, these tests were run by heating the briquettes in a Cenco constant temperature apparatus at the same temperature, for the prescribed sixty minutes, then transferring to the extrusion mold, which, together with the plunger, had been brought to a temperature of 60 degrees Cent. in water placed in a 50-pound whitelead pail, and then placing the pail with its contents under the head of the compression machine and applying the load.

All aggregate was put through a 20-mesh sieve to make results comparative with each other. It happens that the Ottawa sandstone grain practically all passes a 20 mesh, and the same condition exists with the mineral matter of the Kentucky rock asphalt. Crushed granite also contained considerable amounts of 200-mesh material; so for two series this mesh was sieved out.

Examining these grains under the microscope, it was found that lake sand is sharp in sizes smaller than 60 mesh, but as the sizes get larger the sand becomes more round. Ottawa sand is almost completely round in all sizes; quartz and granite are sharp and angular in all sizes. Kentucky rock aggregate is sharp and angular in practically all sizes down to 40 mesh, when it seems to show some evidence of water wear.

Summing up, it can be said that sharpness of grain has a marked influence on the stability of the asphalt mix. This influence persists even after the addition of limestone dust. A sand lacking in stability can be greatly improved by the addition of 200-mesh material. Relative stability is not dependent upon the density of the asphalt mix.

PROBLEMS OF RATE OF SOIL LIMING

By J. A. Slipher
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LIMING the soil is recognized as necessary in crop production over vast areas of the humid region. There has been much investigation of the various phases of the liming problem. An important issue centers around the rate of soil treatment. Just how efficient is lime when applied in graduated rates? It is the purpose of this paper to analyze some of the information available on this question.

According to Truog, the intake of food lime (calcium) by plants appears to be conditional upon the reaction of the soil solution. Whenever the soil solution becomes more acid than the sap of the plant, the crop takes in its food calcium with difficulty. Each kind of crop plant possesses an intrinsic sap acidity. Some, notably alfalfa, are characterized by a weak acidity while others are strongly acid.

Soil-Sap Balance.—The purpose of liming a so-called acid soil is to reduce its reaction to a point milder than the internal acidity of the crop plant to be grown. On a soil of given reaction the magnitude of change necessary to meet the requirement of a specific crop, depending on its sap reaction, may be small or even nil. For another crop, one of mild sap acidity, the relative range could be wide. For one little lime is needed, but for the other much may be necessary to shift the reaction to the point affording the preferred ease and rapidity of lime intake by the plant.

Preference and Critical Reaction Limits for Crops.—For no farm crop is it necessary to lime a soil to the point of neutrality. All crop plants grow successfully on the acid side of the neutral point. A wide difference in preference is noted, however. Alfalfa and sweet clover exhibit difficulty when the soil reaction falls below 6.5 pH. A drop of less than one pH below this level proves extremely injurious. Red clover, on the other hand, possesses a lower range of tolerance, growing successfully at 5.75 pH but showing much distress at about 5 pH. The lower limit of preference for alsike clover stands near 5 pH. Though the soy bean grows satisfactorily on soils with a pH of 4.5, it does best at 5.5 and 6 pH. As a group the cereal crops are more tolerant of acid than the legumes, although most of them do best on soils having pH values as high as 5.5 or 6.

Representative Reaction Value of Soils.—Different types of soil show a wide range of reaction as measured in terms of hydrogen-ion concentration. Ohio soils range between 4.2 pH and 8.5 pH, the majority lying between 4.5 and 7.0 pH.

*Presented Before the Lime Symposium at Richmond, Virginia, April 13th, 1927.

The purpose of adding liming material to the soil is therefore to raise the reaction toward the preferment of the crop. Just how efficient are graduated rates of lime additions in bringing about this change in reaction and in satisfying the crop requirements?

Soil Reaction Changes.—As measured by benefit to soil, light rates of liming are more efficient per unit of lime than heavier rates. The first increment of lime changes the soil reaction more than each additional one. Each added increment in turn produces less change than the one preceding. Recent investigations by Christensen and Jensen offer valuable evidence on this point. Working with Danish soils of different types, they applied multiple increments of lime (each increment 2 kg. $CaCO_3$ per hectare) and measured the resultant pH values. When these pH values are graphed as ordinates against the lime increments as abscissas, curves are obtained as typified by the two in Figure I. In both soils the lightest rate of liming effected the greatest proportionate change in soil reaction. Doubling the rate failed to double the reduction of acidity and added increments brought about progressively less change. Although the additions of lime were in arithmetical relation, the resultant soil reactions were in a geometric relation. The two soils did not respond to the same treatments in the same degree. The stronger buffer capacity of the loamy soil accounts for the lower efficiency of lime on it as compared with its accomplishment on the sandy soil.

Crop Responses.—Light rates of liming produce proportionately more crop growth than heavy rates. The crop responses from graduated increments of lime employed in seventeen comparative tests in the United States show a consistent relationship between rate of liming and crop returns per increment of lime (Table I). In this

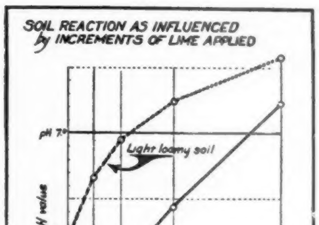

Figure 1

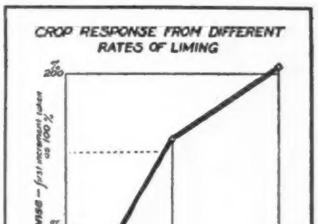

Figure 2

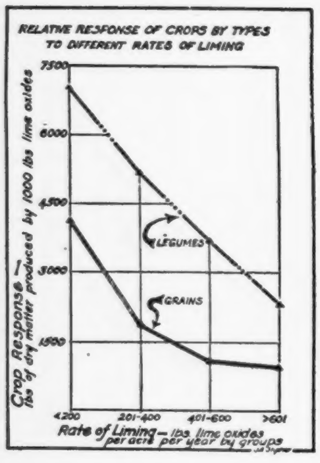

Figure 3

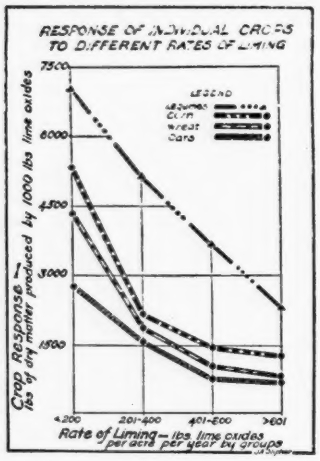

Figure 4

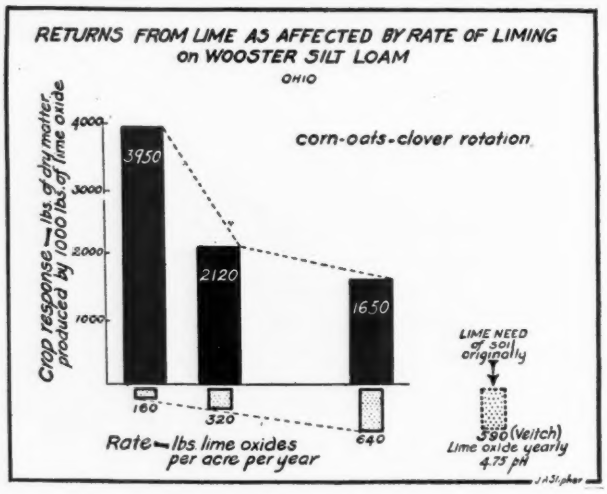

Figure 5

table the crop responses have been converted into pounds of dry matter produced by 1000 pounds of lime oxides in order to have a single standard of measurement. The experiments listed are those in which the results are directly comparable, since all factors other than rate of liming are identical.

Table I—Efficiency of Lime in Terms of Crop Response.

Expt.	State	Soil Type or Series	Crop Rotation	Rate of Liming Oxides per Acre per Year Lbs.	Aver. Crop Response per 1,000 Llbs. Lime Oxides Lbs.
1.	Ohio	Wooster Silt Loam	Corn, oats, clover	640	1,650
				320	2,120
				160	3,950
2.	Ohio	Wooster silt loam	Corn, oats, wheat, clover	2,000	460
				1,000	685
				500	1,100
3.	Ohio	Trumbull silty clay loam	Corn, oats, wheat, clover	666	4,920
				500	5,700
				333	6,670
4.	Md.	Sassafras silt loam	Corn, wheat (clover)	600	3,320
				300	4,810
				150	5,420
5.	Del.	(Coastal Plain)	Alfalfa	800	1,350
				400	3,140
				200	4,510
6.	N. Y.		Mixed hay	400	6,060
				200	10,190
7.	N. Y.		Mixed hay	600	5,670
				300	5,785
8.	R. I.	Merrimac silt loam	Barley, alfalfa, beets, carrots	600	2,385
				200	4,620
9.	Pa.	Westmoreland	Corn, oats, wheat clover and timothy	600	1,820
				150	5,215
10.	Pa.	DeKalb	Corn, oats (wheat) clover and timothy	700	2,880
				150	6,300
11.	Pa.	Volusia	Corn, oats, wheat, clover and timothy	1,025	1,440
				150	5,240
12.	N. J.	Penn loam	Alfalfa (continuous)	400	5,565
				200	7,315
				100	5,950
13.	N. J.	Penn loam	Corn, oats, wheat, oats, clover and timothy	400	2,125
				200	3,540
				100	5,990
14.	Ind.	Clermont silt loam	Corn, wheat, mixed hay	600	1,190
				300	1,725
				150	1,900
15.	Ind.	Sandy muck	Corn, oats, mixed hay	666	1,155
				333	2,060
				150	2,330
16.	Ill.	Gray silt loam on tight clay	Corn, wheat, sweet clover	1,000	2,305
				500	3,480
				250	8,410
17.	Mich.	Fox sandy loam	Alfalfa (2 years)	500	4,070
				250	4,290
				90	5,750

In this table are represented a wide range of soils with respect to lime need and extremes of lime requirement on the part of crops grown.

In general, the crop returns from liming follow a geometric relation, as brought out in Figure 2, in which the crop response for the first increment has been taken as 100 per cent. Here is the same type of curve as in Figure I. It is seen that the first increment of lime produced relatively larger crop response than have additional units of lime. It required the combined effect of three units of lime to yield the same crop increases as the first gave. In most of these experiments the highest rate of liming approximately, and in some instances exactly, met the lime need of the soil, as predetermined by laboratory test of the soil.

In general, the rates of liming were lower in the tests in the western states than in those in the Corn Belt. The crop responses per unit of 1000 pounds of lime oxides showed similar difference, though in the inverse direction.

The findings in Table I indicate that high efficiency from lime is obtainable even though the rate of application lags behind the technical requirement of the soil. This is especially true for those crop rotations made up of our more common crops having an average sensitivity. The question therefore arises as to whether the best interests of the average farmer—having limited funds available for liming—might not be better served by lower rates of application than are commonly recommended. Such a system of liming should provide, however, for greater frequency of treatment.

Relative Responses of Crops

By Types.—Legumes, as a group, respond to the various rates of liming somewhat differently than the cereals. This seems to be due to a difference in sensitivity to lime or lack of lime. In Figure 3 we can see the trend of response for the two types of crops when the rates of lime treatment have been grouped as shown. The legumes (alfalfa, sweet clover, and red clover) approach an arithmetic type of curve, whereas for the cereals (corn, wheat, oats, and barley) the curve is distinctly geometric.

Individual Crops—The several individual crops have shown a consistent and regular response in accordance with the rates of liming. Upon dividing the rates into four general groups and converting the crop returns into pounds of dry matter produced per thousand pounds of lime oxides, we obtain values as set forth in Table II and Figure 4.

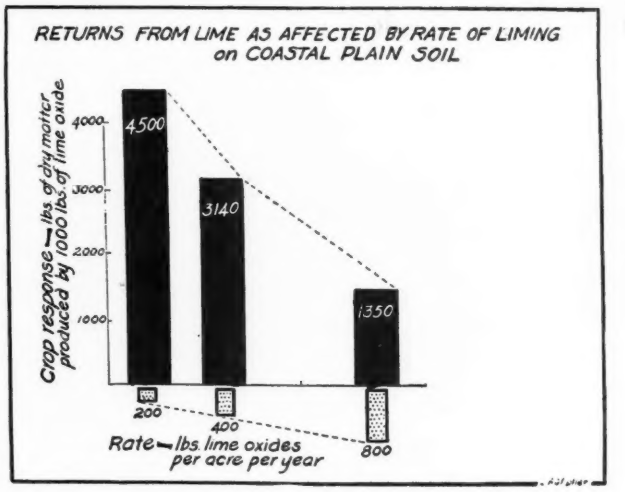

Figure 6

Table II—Relative Response of Specific Crops by Rates of Liming

(Lbs. dry matter per 1000 lbs. lime oxides)

	Rate per Acre per Year			
Crop	Less than 201 lbs.	201 to 401 lbs.	401 to 601 lbs.	More than 601 lbs.
Corn	5331	2160	1460	1300
Oats	2750	1560	765	740
Wheat	4335	1836	1022	830
Legumes	7030	5143	3680	2288
Average	4861	2674	1732	1289

In general, the absolute responses of the cereals were lower than for legume crops, the latter including alfalfa, sweet clover, but more generally red clover. Corn surpassed the small grains at all rates of liming. This seems logical in view of the fact that corn generally follows immediately the legume in rotation and profits from the large supply of nitrogen acquired by the legume and by the favorable rate of nitrification fostered by the presence of the added lime. Wheat stands next in order among the cereals, followed at a somewhat lower level by oats. The wide range of soils involved in these summaries emphasizes the importance of the trends of returns as well as the absolute returns from lime.

All the cereals give a characteristic geometric curve of almost identical slope. Though not shown in the data presented herewith, the returns on alfalfa on Penn loam at the New Jersey Experiment

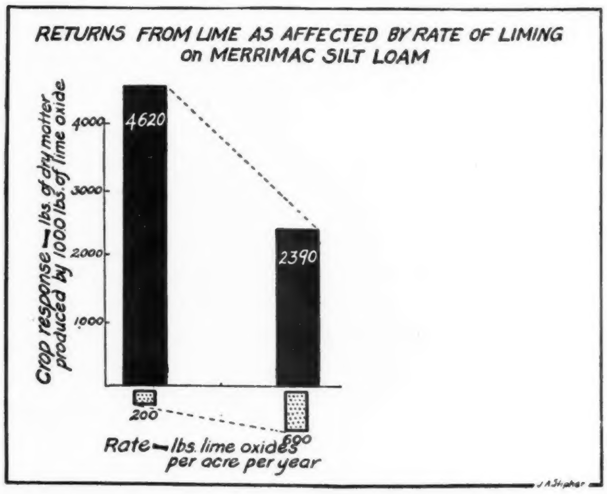

Figure 7

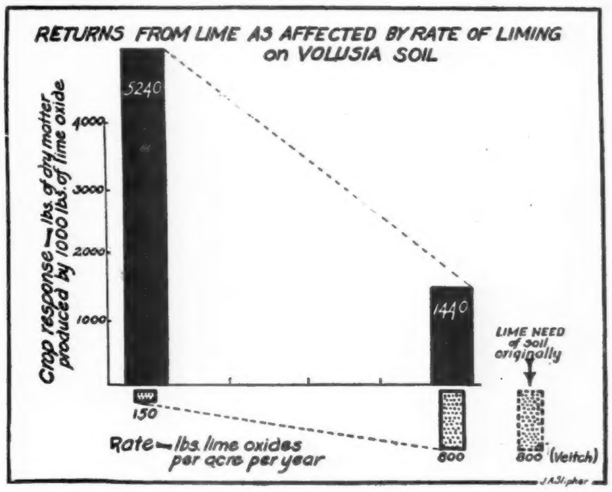

Figure 8

Station gave a greater increase with the second increment than with the first, indicating that with crops of high sensitivity, such as alfalfa and sweet clover, the greatest efficiency may be with the medium rate of liming rather than with the lightest.

Some of the soils included in this study have a high or moderate need for lime as determined by the common laboratory methods. Irrespective of the absolute lime need of each, however, the responses to light rates of liming have exceeded the returns from multiple increments when all crops in the rotation are considered. A few of the representative findings are illustrated in Figures 5 to 9.

Wooster Silt Loam of Ohio.—As an average of a 14-year test at the Ohio Experiment Station with corn, oats, and clover in rotation this loam gave superior returns with a 500-pound application of burnt lime once in 3 years (Figure 5). According to Veitch's method, the lime need of the untreated soil was about 1800 pounds of lime oxide per acre, which would be about 600 pounds per year. Its hydrogen-ion reading was 4.75 pH.

Coastal Plain Soil of Delaware.—This soil, which is probably of the sassafras sandy loam type, shows a falling off in efficiency with the second increment of lime which is less pronounced than in the Wooster experiment (Figure 6). Alfalfa was grown continuously at the Delaware Experiment Station and, being a high lime-requiring crop, utilized the double lime application more efficiently than did the less exacting crops in the Ohio experiment.

Merrimac Silt Loam.—On this soil growing alfalfa, beets, carrots, and barley, the Rhode Island Experiment Station obtained comparative efficiency of lime on 6-year returns, as diagrammed in Figure 7. The liming was at the rate of 1200 pounds of lime oxides per acre, both hydrated lime and finely pulverized limestone being employed. Tripling the rate was not followed by a corresponding crop response, indicating that a lighter rate would bring better efficiency on this soil even with the more sensitive crops such as alfalfa and beets.

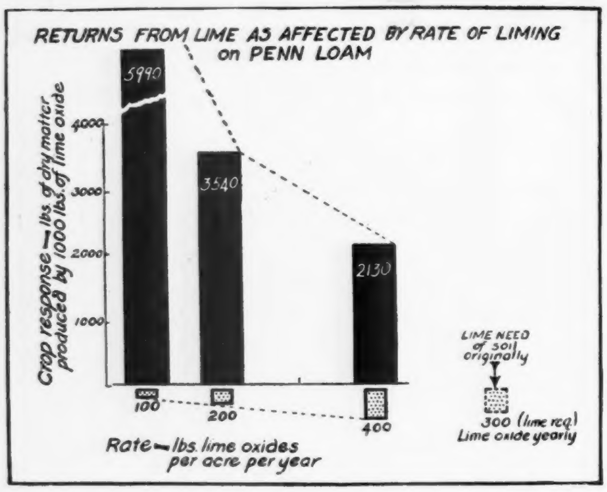

Figure 9

Volusia Soil.—Three outstanding experiments showing the superior efficiency of light rates of liming are those conducted by White of Pennsylvania, on the Volusia, DeKalb, and Westmoreland soil series. The returns for the Volusia soil (Bradford County, Pa.) only are given in Figure 8. In spite of the high lime requirement of this soil, 4100 of lime oxide per acre, the returns on corn, oats, wheat, and clover and timothy mixed in 4-year rotation proved surprisingly efficient from a lime application affording only 150 pounds of lime oxide per acre each year as against the 850 pounds per year required to bring the soil to the neutral point. In Table I it is seen that similar returns were had in the case of the DeKalb and Westmoreland soils, both of which have lime needs approximately two-thirds that of the Volusia.

Penn Loam.—Having a lime requirement of 1500 pounds of lime oxide per acre (equivalent to 300 pounds per acre per year) the Penn loam, representing Piedmont Soil Province, at the New Jersey Experiment Station responded to 1000, 2000, and 4000 pounds of limestone applied once in 5 years as illustrated in Figure 9. The rotation consisted of corn, oats, wheat, and clover and timothy hay. Obviously, with crops of their tolerance grown on this type of soil, modest applications of lime will suffice for highest efficiency.

Conclusion

In evaluating liming in terms of the efficiency per unit of lime, the magnitude of both the change in the relation of the soil and the crop response are arguments for the lighter rates of application. The sensitivity of the crop as well as the intrinsic need of the soil for lime are extenuating conditions that modify the amount of the application. In general, it appears advisable to use lower rates of application than have been commonly advised in the past.

Economic Building Height

The opponents of the skyscraper have become so thoroughly imbued with a fanatical zeal that, like most reformers, they are totally blind in one eye. Their distress over the plight of the poor pedestrian and the still more unfortunate motorist at rush hours makes them see the skyscraper problem only in its length and breadth—never in its height. And height, strange to say, is the most interesting thing about the skyscraper. The fact that the tall building, eight hours per day, renders an economic service in concentration and efficiency never before possible in the history of man, escapes their notice entirely.

In modern business, concentration is all-important because, in the final analysis, all business deals, no matter how vast or how complicated, are based on the simple law of barter and sale. Now barter and sale mean personal contact. Such being the case, the skyscraper has not outlived its usefulness yet. Anything that helps to consummate a deal quickly and with the least waste of motion is a boon in this day and age. From the twenty-eighth story of the Equitable Building to the tenth floor of the Bankers' Trust is a quick jump because the travel is mostly vertical. Flatten out the financial district to eight or ten stories and those offices might be ten or twelve blocks apart, and the traffic on the surface would be just that much more congested.

The die-hard opponents of the skyscraper, when they talk about flattening out Manhattan Island to a level ten stories throughout its area, seem to have forgotten all about the elevator. Perhaps they do not realize that there is as much vertical traffic as horizontal in New York's financial district during business hours. Maybe more. In fact it would not be difficult to prove by means of a careful survey that in this section of the city there is less traffic congestion, both pedestrian and vehicular, during the important hours than in sections where the average building height is less than one-third of what it is down town.

When our forefathers laid out the lower end of Manhattan Island in country lanes and cow paths, they could hardly have foreseen its present aspect. But in spite of the inadequacy of its original plan, New York has become the greatest city in the world, chiefly because of that group of skyscrapers which have made history. Perhaps if the entire area of Manhattan Island were allowed to grow up in forty-story skyscrapers of the crackerbox type, without regard to transportation, traffic, light or air, it would be disastrous to the business of the city. But it is hardly likely that the men whose ingenuity and common sense created the present-day marvel of the skyscraper will kill the goose that laid the golden egg.

LIME IN THE TREATMENT OF PEA CANNERY WASTES

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METHODS for satisfactorily and economically disposing of cannery wastes in the prevention of nuisances and objectionable stream pollution have been sought by canners, chemists, and sanitary engineers for a number of years. Those developed have been but partially successful or only of local application. The problems presented by the untreated wastes having become more acute with industrial expansion, in several states, considerable effort has been recently directed toward their solution. The primary purpose of this paper is to give details and results concerning an investigation conducted at Poynette, Wis., during the past canning season in the treatment of pea cannery wastes with ferrous sulfate and lime.

The investigation was conducted jointly by the Wisconsin Canners' Association, State Board of Health, and State Conservation Commission, funds to cover the cost of chemicals and equipment being furnished by the Canners' Association and the necessary technically trained personnel being provided by the state through an appropriation for the control of stream pollution. Under the agreement the technical phases of the work were directed by the Bureau of Sanitary Engineering of the State Board of Health, and the field work was performed by members of the staff. All possible assistance was rendered by officials of the Canners' Association as well as local officials at the cannery selected for the investigation.

Normally, about half of the nation's canning peas are produced in Wisconsin. Since a number of the canneries in the state pack peas exclusively, and as the wastes produced offer the most difficult disposal problem, it was decided to devote all treatment activities to these specifically. The problem is rendered particularly difficult by the facts that the periods of hottest weather and lowest stream flow generally occur during the pea-canning season. Consequently, it is apparent that these wastes need most thorough treatment in the prevention of local nuisances and serious stream pollution.

A review of all available literature concerning the treatment of canning-plant wastes was made before starting experimental work. Very little information could be found concerning the treatment of cannery wastes generally, and pea cannery wastes in particular. A divergence of opinion was expressed as to the success and practicability of treating the wastes by chemical methods. The New Jersey State Board of Health concluded after a laboratory study of tomato-canning wastes that screening alone or treament with lime, ferrous sulfate, calcium sulfate, clay and alum, either singly or in various combinations, would not yield a stable, clarified liquor. Settling tanks were recommended as preliminary treatment, the effluent being discharged into a stream if sufficient dilution was afforded, otherwise onto a ploughed field.

The New York State Board of Health has also recommended tank treatment for the pea cannery wastes, but it has been found that there is very little improvement in the character of the effluent as compared with the influent. A chemical-precipitation waste treatment process is used by the A. & P. Products Corporation at their cannery in Brockport, N. Y., with satisfactory results. The treatment consists of screening to remove coarse solids, followed by the addition of ferrous sulfate and lime in amounts equivalent to 1.7 pounds of ferrous sulfate and 12.9 pounds of lime per 1,000 gallons of waste.

The Illinois State Water Survey concluded from canning-factory waste disposal experiments at Washington, Ill., that the problem was adequately solved by discharging the screened wastes on broad irrigation beds. Chemical precipitation experiments on a laboratory scale, using varying amounts of alumina cream as a precipitant for corn-canning wastes, led to the conclusion that such treatment was of little practical application.

Experiments in the treatment of tomato-canning wastes conducted by the United States Public Health Service at Amelia, Ohio, indicated that about 85 per cent of the suspended matter could be removed by tank treatment, and that a clear, non-putrescible effluent could be obtained by first filtering the settled wastes through beds of coarse cinders and later through beds of sand. Preliminary tests by the Wisconsin State Board of Health during the pea-canning season of 1925 indicated that the application of 5 pounds of ferrous sulfate and 7 pounds of lime per 1,000 gallons would effect a reduction of from 60 to 70 per cent in the organic matter.

The results of these tests, together with the lack of definite data in the literature concerning the

*Presented before the Symposium on Lime at Richmond, Va., April 18, 1927.

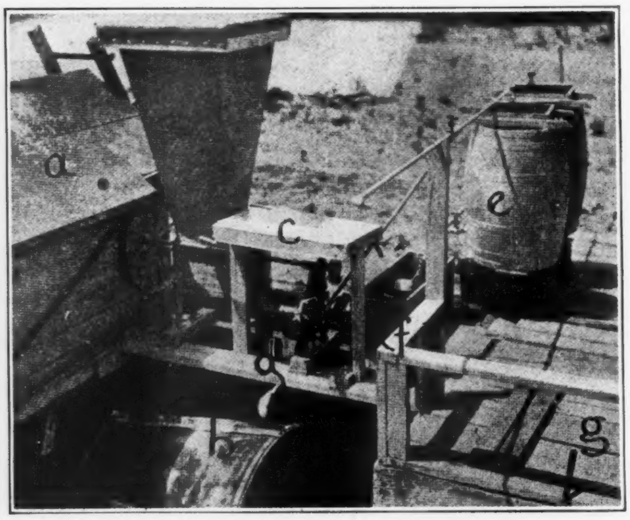

Figure 1—Chemical Feed Equipment and Screen Unit of the Pea Cannery Waste Treatment Plant, Poynette, Wis.
a—Motor house
b—Screen unit
c—Dry feeder for lime
d—Discharge pipe for lime
e—Ferrous sulfate solution tanks
f—Orifice tank for ferrous sulfate
g—Chemical precipitation tank

chemical treatment of pea cannery wastes, suggested the investigation under discussion. Chemical rather than biological methods were advocated because of the time required for the latter to become effective and the short duration of the pea-canning season.

A brief discussion of the characteristics of the various pea-canning wastes is necessary to give a clear conception of the problem. To facilitate discussion the wastes have been classified according to their source, as follows:

I—Viner wastes (produced by threshing peas).
- (1) Vines—used as stock food.
- (2) Sileage juice—seepage from stacked vines.

II—Factory wastes (produced in the canning process).
- (1) Produce washings—before and after blanching.
- (2) Blancher effluent.
- (3) Floor washings.
- (4) Water used to cool canned peas after sterilization.
- (5) Sewage from toilets and lavatories.

Viner Wastes.—Canning peas are harvested in a manner somewhat similar to hay or grains. The vines are cut and carted to viners, in which the peas are removed by a threshing process. The vines are stacked in the open or in silos to be used as food for stock.

Analyses of Pea Vine Silage

	Moist Sample Per cent	Dry Basis Per cent
Moisture at 100° C.	77.49	...
Crude protein	3.566	16.027
Ether extract	0.839	3.777
Crude fiber	6.556	29.466
Nitrogen-free extract	8.708	39.134
Crude ash	2.582	11.602

The fermentation of this silage is often responsible for very disagreeable odors in the vicinity of the viner stations. The care of the stacks to prevent local nuisances involves cleanliness around the stack and the free use of lime as a disinfectant and deodorant. In threshing, the vines are bruised and macerated and, on stacking, the moisture seeps out and percolates down through the vines, acquiring a very high organic content. This liquid stack effluent is the so-called silage juice. It decomposes rapidly, giving off very offensive odors, and when discharged into a small stream it uses up the dissolved oxygen necessary for fish and certain other aquatic life. Analyses of the waste give an oxygen-consumed value of 39,100 p. p. m., approximately 260 times that for strong domestic sewage. The volume during maximum flow is estimated at 1,000 to 1,500 gallons per day per 100 acres of vines.

Lime treatment for this waste has resulted in some improvement, but is not regarded as entirely satisfactory. Chemical precipitation experiments produced an amount of sludge almost equal to the original volume of the silage juice. Present practice, however, to locate viner stations on farms rather than at the cannery in order to make unnecessary long hauls of vines by the farmer has materially simplified the disposal problem. The volume of silage juice at any one station being comparatively small, it can generally be disposed of by soil absorption or by spreading and plowing under on nearby land. In view of the high organic content of silage juice containing appreciable amounts of carbohydrates, it is possible that starch, sugar, alcohol, and other such by-products might be economically recovered. This is a matter for consideration by the canning industry, no attempt having been made to utilize or treat viner wastes in the experimental work at Poynette, Wis.

Factory Wastes.—The blancher effluent produce and floor washings constitute the objectionable wastes resulting from the pea-canning process proper, which require special treatment. The other factory wastes are of secondary importance in the general problem, since the cooling water is unpolluted and the disposal of domestic sewage is a separate consideration.

The blancher effluent is the strongest waste produced in the pea cannery. It contains the gummy coating from the surface of the peas together with the organic constituents removed during the blanching process in colloidal and true solution. Analyses by Abel and Wiley, and reported by Bitting, give some idea as to the character of the organic matter.

Analyses of Peas
(Results expressed as percentage of total)

Authority	Water	Protein	Fat	Starch	Cellulose	Ash
		Analyses of Green Peas				
Abel	74.60	7.00	0.50	16.90	...	1.00
Wiley	79.93	3.87	0.49	13.30	1.63	0.78
		Analyses of Canned Peas				
Abel	85.30	3.60	0.20	9.80	...	1.10
Wiley	85.47	3.57	0.21	7.79	1.18	1.11
		Gain or Loss in Constituents in Canning Process				
	(Gain)	(Loss)	(Loss)	(Loss)	(Loss)	(Gain)
Abel	10.70	3.40	0.30	7.10	...	0.10
Wiley	5.54	0.30	0.28	5.51	0.45	0.33

These analyses indicate that about 42 per cent of the carbohydrate content of the green peas is removed in the canning process. The carbohydrate content, according to analyses by Peterson and Churchill, comprises 54 to 60 per cent of peas, about 80 per cent being starch and 20 per cent galactans, pentosans, and other fermentable sugars. A considerable portion of these constituents is believed to be in true or colloidal solution in the blancher effluent, together with at least a part of the organic matter represented by the reductions in protein, fat, and cellulose contents.

Researches by Buswell, Greenfield, and Shive concerning the characteristics of pea cannery wastes, in which 1.1 per cent alcohol was formed by yeast fermentation of blancher effluents, provide further evidence of the presence of fermentable sugars. The oxygen consumed value for this waste, 130 to 170 times greater than that for domestic sewage, is ascribed to these sugars. An oxygen demand of 11,000 p. p. m. reported for the same waste is undoubtedly due to the conversion of the proteins and carbohydrates to more stable compounds.

Because of the large unstable organic content of the blancher effluent, and resultant high oxygen requirement, it is considered the most objectionable of the factory wastes from the stream pollution point of view. The other wastes contain considerably less organic matter in true solution. Wastes produced in washing peas before blanching contain dirt, broken pods, and pieces of vines, while those produced in rewashing after blanching contain largely light-weight split peas and loose skins, a large portion of which can be removed by the screen unit of a treatment plant. This applied also to the floor and machinery washings, which contain dirt, waste peas, and other such substances, but only a relatively small amount of organic matter in true solution.

As stated previously, the cooling water and domestic sewage do not enter into the general treatment problem. The former, having received no organic matter, is either by-passed around a cannery-waste treatment plant or utilized as a boiler feed water to reduce fuel costs. The domestic sewage is usually discharged into the local municipal sewer system, when such is available, or disposed of separately, since the cannery-waste screenings are frequently used as hog feed. The wastes treated in the Poynette experiments included only the blancher effluent and produce and floor washings. There were no viners at the cannery, all being situated on nearby farms where the silage juice was disposed of by soil absorption. The cooling water was used for boiler feed purposes and the domestic sewage was taken care of by septic tank and dry well.

The volume of canning-plant wastes for all practical purposes can be considered equal to the total

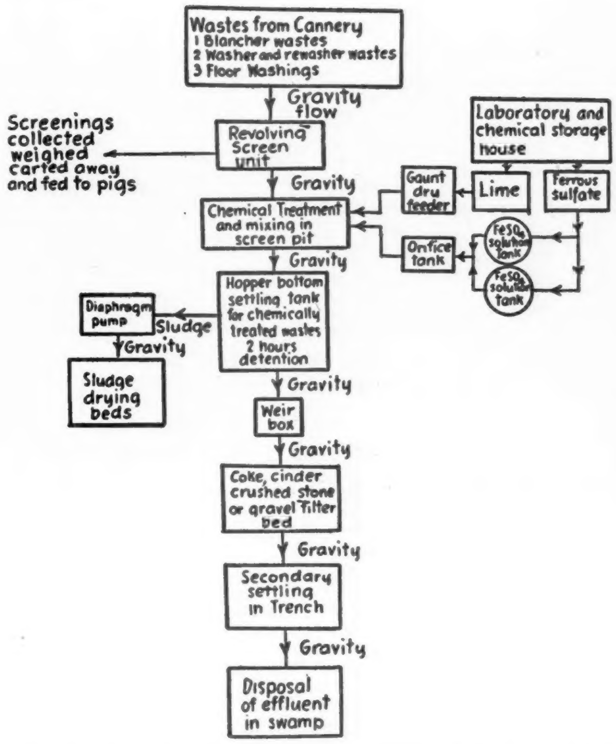

Figure 2—Flow Sheet for the Experimental Plant Used in the Chemical Treatment of Pea Cannery Wastes, June-July, 1926

daily water consumption. This amounts to about 100,000 gallons for an average two-line pea cannery, equivalent to one gallon of water per can (No. 2 size). Since the water is used in about 12 hours, the rate of consumption is approximately twice this figure.

Before the field work in the chemical treatment of pea cannery wastes was started, certain preliminary experiments were conducted in the Sanitary Engineering Laboratory, University of Wisconsin. These experiments, with wastes artificially prepared from canned peas, involved the application of various preciptants to ascertain which were most effective in removal of the organic matter.

The results obtained in this experimental work indicated that:

1. Lime and ferrous sulfate treatment will accomplish good clarification and bring about a material reduction in the oxygen demand of the waste.

2. Similar results can be obtained with lime and alum, but much more careful control is required than in the treatment with ferrous sulfate and lime.

3. To obtain good results in either case, thorough mixing of the chemicals and wastes is essential.

4. Further reduction in the oxygen demand of the clarified waste is effected by aeration.

5. The addition of clay, fuller's earth, and other such substances to the waste does not materially aid in the chemical coagulation and precipitation of the organic matter.

6. Hydrogen-ion concentration and biochemical oxygen demand tests can be used in controlling and

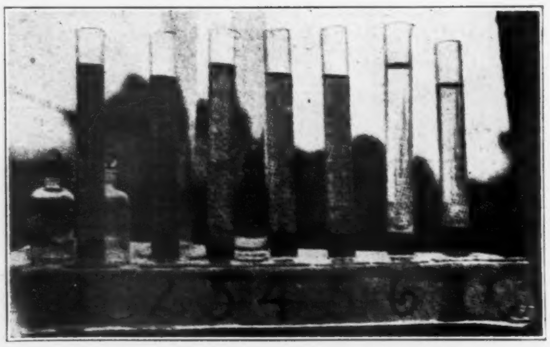

Figure 3

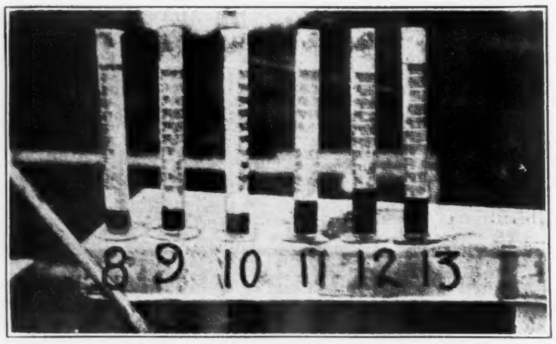

Figure 4

Cylinder Control Tests Showing Results of Effective and Ineffective Treatment of Pea-Canning Wastes With Lime and Ferrous Sulfate. (See Table I)

measuring the effectiveness, respectively, of the chemical treatment applied to the waste.

These results of the preliminary studies were used as a guide in planning the experimental investigations carried out in the field during the pea-canning season of 1926.

A modern two-line pea cannery with a daily capacity of 100,000 No. 2 cans, owned by the Poynette Canning Company, was selected for this field work. The selection was made on the basis of convenient location to Madison and of good facilities provided for the waste treatment investigation. The company had previously installed a rotary screen unit and settling tank for the factory wastes, exclusive of the cooling water and domestic sewage which, as previously mentioned, were disposed of separately. Since chemical treatment had been contemplated in this installation, only a little added equipment and construction were necessary before the experimental work could be carried out.

The modified treatment plant consists of a rotary screen unit, feed-regulating devices for lime and ferrous sulfate, mixing facilities, a hopper-bottom chemical precipitation tank, sludge pumping and drying equipment, and apparatus for flow measurements. Some of these units are shown in Figure 1, while the flow sheet for the treatment process is presented in Figure 2. The Berlin rotary screen used at Poynette is covered with a 20-mesh wire and is driven at 18 r. p. m. by a one-horsepower electric motor. The wastes enter in at one end of this unit and flow out through the 20-mesh wire covering into the screen pit, where they are mixed with the lime and ferrous sulfate. Mixing is facilitated by six angle-iron ribs fastened to the outside of the rotary screen. Lime treatment is regulated by means of a Gaunt dry feeder, a spray device being provided in the discharge spout to dissolve the lime partially and prevent it from blowing about as a fine dust. High-calcium, hydrated lime is used in the treatment of the wastes, since it is considered essential to satisfactory results. Ferrous sulfate is added as a solution of known strength, the dosage being controlled by an orifice tank. As a portion of the coagulating value of the ferrous sulfate is lost by this method of application, a dry feeder for this chemical is much more desirable.

After addition and thorough mixing of the chemicals with the cannery wastes in the screen pit, they flow into the hopper-bottom settling tank. This tank is built of reinforced concrete, with inside dimensions of 30 by 12 by 3 feet effective depth. The two hoppers, shaped like inverted pyramids, have a slope of 1:12, instead of 1:2 according to the original design. This change in specifications by the contractor, made because of local soil conditions, was the cause of some difficulty in sludge removal. Wooden baffles extending 6 inches below the flow line were built across the tank near the outlet to provide equal distribution of flow through the tank and prevent scum from escaping with the effluent. Because of a scouring action, due to the flow being directed downward at the inlet end, the baffle there was replaced by a galvanized iron trough during the latter part of the investigation.

Three sludge-drying beds were provided by sinking wooden frames 10 feet square by 1 foot deep into the sandy soil surrounding the treatment plant. At the start of the work a small pitcher pump was used in transferring sludge from the tank to the drying beds, but, this being unsatisfactory, a small electric motor-driven centrifugal pump was installed for the purpose. It gave continual difficulty in operation, however, and was finally replaced by a 4-inch gasoline-driven diaphragm trench pump with very good results.

The effluent from the treatment plant was measured during the experimental work by a weir and continuous flow recorder. It was then passed through a small lath and gravel filter used as a catch-all for any peas, pods, or such material that might pass through the tank, and finally discharged into a small stream bordering a nearby swamp. The effect of the treated waste on this stream is discussed later.

Waste treatment was commenced at the beginning of the pea-canning season, every effort being concentrated on ascertaining the lime and ferrous sulfate dosages most effective for clarification and removal of the unstable organic matter. Oxygen demand, oxygen consumed, turbidity, and pH determinations, made in accordance with standard methods, were used as field control tests. The ratio and quantities of lime and ferrous sulfate added to the wastes were varied, samples were collected at the inlet of the tank and allowed to settle in graduated cylinders, and the control tests were applied to the supernatant liquid. Some of the cylinders showing the clarification accomplished by different treatments are presented in Figures 3 and 4, while results of the control tests made with each are given in Table I.

In Figures 3 and 4 the differences in the degree of clarification accomplished by various amounts of lime and ferrous sulfate are clearly brought out. The lime dosages were varied from 3.6 to 26.4 pounds, and those for ferrous sulfate from 0.5 to 2.1 pounds, per 1000 gallons of waste. Cylinders 1 to 5 show ineffective treatment, resulting from the use of insufficient lime to react with the ferrous sulfate in the formation of a satisfactory floc. The remaining cylinders, 6 to 13, are representative of effective treatment. The large amount of precipitate in the last three cylinders was due to the collection of these samples during the clean-up period, when the treatment was increased to take care of the large volume of floor and machinery washings and blancher wastes.

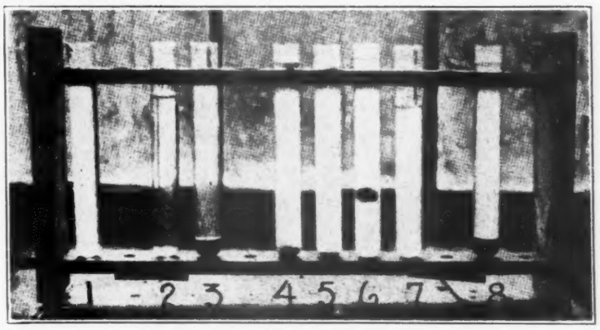

Figure 5—Samples of Treated Pea Cannery Wastes Showing Effect of Sludge Decomposing and Going into Solution. This partially accounted for the poor results obtained during the first part of the investigation at Poynette, Wis. (See Table I)

The analytical results given in Table I, obtained with the simultaneously collected samples of raw and treated wastes in these cylinder control tests, indicate that with ineffective treatment the oxygen consumed values of the raw wastes were reduced from 1.2 to 18.2 per cent, and with effective treatment from 18.8 to 51 per cent. Comparison of biochemical oxygen demand tests made with the untreated wastes and clarified supernatant liquids in the cylinders gave reductions ranging from 22 to 67 per cent. Subsequent tests indicated that greater reduction in oxygen consumed and biochemical oxygen demand values could be accomplished

Table I—Results of Cylinder Control Tests—Chemical Treatment of Pea Cannery Wastes

Cylinder	Chemicals		Chemical Analyses					Sludge		Observations
	$FeSO_4$	Lime	Sample	Oxygen consumed	Oxygen demand*	pH	Turbidity	Cc./250 cc.	% by Vol.	
	Lbs./1000 gal.			P. p. m.	P. p. m.		P. p. m.			
			Raw	1720	...	7.4	700			Tan floc; poor coagulation and precipitation.
1	0.83	4.0	Treated	1700	...	9.8	450	20	8	
			% Reduction	1.2	...	...	35.7			
			Raw	2060	...	7.3	600			
2	1.16	3.57	Treated	1820	...	9.6	450	32	12.8	
			% Reduction	11.7	...	...	25			
			Raw	2190	...	7.2	1000			Green and tan floc; poor coagulation and settling action.
3	1.84	4.14	Treated	1950	...	8.8	450	23	9.2	
			% Reduction	11	...	...	55			
			Raw	2250	2650	7.4	600			Blue-green, rapidly settling floc; poor clarification. (New $FeSO_4$ solution).
4	1.96	4.3	Treated	1840	2250	8.9	250	34	13.6	
			% Reduction	18.2	15	...	48.4			
			Raw	3030	...	7.2	1000			
5	1.37	13.8	Treated	2540	...	9.2	320	30	12	
			% Reduction	16.2	...	...	68			
			Raw	2860	4050	7.6	600			Brownish green, rapidly settling floc; very good clarification.
6	2.1	12.7	Treated	1480	1333	10.0	100	34	13.6	
			% Reduction	50	67	...	83.3			
			Raw	2960	1302	7.4	900			
7	1.86	11.3	Treated	1580	550	10+	75	42	16.8	
			% Reduction	46.6	58	...	91.7			
			Raw	1640	1750	7.6	800			Tan, rapidly settling floc; clear supernatant liquid.
8	0.72	10.1	Treated	1226	1250	10+	50	30	12	
			% Reduction	25.8	29.6	...	93.8			
			Raw	2980	3650	7.0	850			Tan floc but only fair clarification.
9	0.56	11.4	Treated	2420	2850	10+	180	30	12	
			% Reduction	18.8	22	...	78.8			
			Raw	3140	3750	7.4	900			Tan, rapidly settling floc with fair clarification.
10	0.52	18.6	Treated	2060	2550	10+	90	32	12.8	
			% Reduction	34.5	32	...	90			
			Raw	3080	1050	7.3	800			Tan, rapidly settling floc; good clarification; clean up.
11	0.89	21.3	Treated	1840	450	10+	70	50	20	
			% Reduction	40.3	57	...	91.3			
			Raw	3060	2450	7.0	310			Brownish green, rapidly settling floc; very clean start of blancher waste.
12	1.87	25.4	Treated	1500	1000	10+	25—	70	28	
			% Reduction	51	60	...	92+			
			Raw	...	23,400	6.8	900			Dense blue-green, rapid settling floc; concentrated blancher waste.
13	0.50	14.0	Treated	...	15,000	8.9	200	50	20	
			% Reduction	...	36	...	78			

*5-day at 20° Cent.

Figure 6—Removal of Sludge from Drying Beds of Pea Cannery Waste Disposal Plant, Poynette, Wisconsin

with ferrous sulfate dosages in excess of 2 pounds per 1000 gallons of waste. Best results were noted when the pH value of the treated wastes was 10 or higher. The clarification effected is shown by the decrease in turbidity, practically all the suspended matter being removed with effective treatment in the cylinder tests.

In the operation of the treatment plant, composite samples of the raw and treated wastes were collected for the complete chemical analysis to determine the efficiency of the process in the removal of the unstable constituents. Though the results obtained for the first few days indicated effective treatment, this efficiency rapidly decreased. A thick scum appeared at the surface of wastes in the tank and considerable suspended matter was observed in the effluent. Increasing the chemical treatment did not improve the situation. The sludge, which had been allowed to accumulate in the tank due to inadequate sludge-removal facilities, was apparently escaping with the treated wastes either in suspension or in solution.

To ascertain whether a partial solution of the sludge occurred when allowed to remain in the tank, test-tube samples of the treated wastes were collected at the tank inlet on successive days until they covered a week's operation. The tubes were allowed to stand at laboratory temperatures with the clarified supernatant liquid in contact with the precipitated organic matter. Daily observations

Table II—Results Showing Need of Frequent Sludge Removal*

Date	Chemicals $FeSO_4$	Chemicals Lime	pH Treated Wastes	Per Cent Reduction: Oxygen Demand	Oxygen Consumed	Turbidity	Solids: Suspension	Solids: Total
Settling Tank Partly Filled With Sludge								
July 9	3.97	16.14	9.8—	34.0	30.1	61.8	......	......
July 12	6.10	24.71	9.8—	....	71.4	56.5	(increase) —49.5	—31.0
July 19	1.38	7.86	9.8—	....	12.8	67.0	......	......
Average	3.81	12.24	9.8—	34.0	38.1	61.8	—49.5	—31.0
Settling Tank Clean								
July 26	2.08	4.48	9.8	77.4	66.1	67.4	......	......
July 28	3.77	9.11	10—	77.0	57.2	82.2	39.9	39.0
July 30	3.68	8.17	10	74.5	66.0	68.0	......	......
Average	3.18	7.25	10	76.3	63.1	72.5	39.9	39.0
Increased efficiency				42.3	25.0	10.7	89.4	70.0

*Complete chemical analyses will be published in a joint report of the Wisconsin State Board of Health and Conservation Commission.

were made to determine whether the sludge changed in volume or character.

The appearance of the test-tube samples at the end of a week is shown in Figure 5. The character of the plant effluent, obtained with accumulations of sludge in the settling tank, is shown in tube No. 1, even though the lime and ferrous sulfate treatment applied would effect good clarification in samples collected at the inlet end of the tank and allowed to settle in cylinders, as shown in the tube No. 2. Test tubes Nos. 3, 8, 4, 5, 6, and 7 show the character of the clarified wastes which had been in contact with the sludge from 1 to 6 days respectively. Though little change in the volume and character of the sludge was noted during the first 2 days, there was an appreciable increase in the turbidity. On the fifth day the sludge was carried to the surface by the gases of decomposition as shown in No. 6. The sludge which had collected as a scum at the top of No. 7 had been removed for other purposes before the picture was taken. All observations indicated decomposition and partial solution of the sludge.

Since the clarified wastes, when removed from contact with the sludge, could be kept for an indefinite period without visibly changing in character, while the same wastes allowed to remain with the sludge would rapidly deteriorate in character and appearance, it was concluded that daily cleaning of the tank would be essential in preventing the chemically precipitated organic matter from decomposing, rising as a scum, and being carried away with the plant effluent.

The improvement in operating results obtained with daily removal of the sludge is shown in Table II. An increased efficiency of 25 per cent based on the oxygen consumed tests, and of 42 per cent based on the oxygen demand tests, was obtained under the modified method of operation. With the tank clean, reductions in biochemical oxygen demand and oxygen consumed value of the raw waste averaged 76 and 63 per cent, respectively. This indicates very definitely that material reduction in stream pollution caused by untreated pea cannery wastes can be accomplished by the lime and ferrous sulfate treatment process.

Considerable sludge is produced in the chemical treatment of pea cannery wastes. The amount removed from the settling tank was not measured, but from the results of the cylinder control tests the quantity of sludge is between 10 to 15 per cent by volume during normal operation, increasing somewhat during the clean-up period, when the dosages of lime and ferrous sulfate were relatively greater.

The sludge was pumped on the drying beds, where it rapidly dried without producing objectionable odors. The appearance of the dried material as it was being removed from the beds by the plant operator is shown in Figure 6, no difficulty being experienced in the process. Analyses of the sludge as a fertilizing material made by the Division of Feed and Fertilizer Inspection, Wisconsin Department of Agriculture, were as follows:

	Per Cent
Moisture	41.33
Total nitrogen	0.50*
Total phosphoric acid	3.63*
Available phosphoric acid	3.31*
Potash	.....
Neutralizing value (expressed as per cent $CaCO_3$)	32.8*

*Dry basis.

From these results the estimated value of the sludge as a fertilizer is between $3.00 and $3.50 per ton, enough to warrant its removal by nearby farmers.

Final disposal of the treated wastes at Poynette was by dilution in a small stream. In reaching this stream the wastes had to flow about three-fourths of a mile in a ditch bordering a swamp. Some dilution was provided en route by swamp drainage at the start of the canning season, but this became almost negligible during the hot, dry weather in the last 2 weeks of July.

To ascertain the effect of the treated wastes on the stream, dissolved oxygen surveys were made during the course of the experimental work. The results obtained at the beginning indicated but slight depletion of the oxygen in the diluted wastes at the edge of the swamp and none in the main stream, but those obtained at the end of the canning season showed an appreciable decrease in the oxygen content of the stream. The reductions, however, were attributed largely to accumulations of organic matter carried through the tank during the early part of the work, and to decreased stream flow.

No offensive odors were caused by the lime and ferrous sulfate treatment of the pea cannery wastes or by the method of sludge disposal. Though a slight sour odor was noticed near the ditch at the edge of the swamp during the hot weather, no local nuisance was created. This could probably have been prevented if effective treatment had been maintained throughout the work. According to employees of the canning company, conditions were much improved over those existing when no chemical treatment was applied.

There are a number of pea canneries in Wisconsin which discharge wastes into municipal sewerage systems. These wastes impose a heavy burden on sewage disposal plants, frequently resulting in their failure to function satisfactorily during the canning season. Accordingly, experiments were conducted by canners at Ripon and Oconomowoc, Wis., in the coagulation of the canning factory wastes with lime and ferrous sulfate prior to discharging them into the city sewers. The object was to ascertain whether such treatment would obviate the necessity of sludge removal in tanks at the cannery in such cases. The results indicated that little is accomplished in improving conditions at the sewage disposal plants, and that removal of the coagulated organic matter at the cannery is essential.

Conclusions

1. The oxygen demand for pea cannery wastes can be reduced approximately 75 per cent by screening and tank treatment with the application of 7¼ pounds of lime and 3¼ pounds of ferrous sulfate per 1000 gallons.

2. Prompt removal of the chemically precipitated organic matter is desirable, since a portion goes into solution when allowed to accumulate in the tank. The oxygen demand reduction averaged only 34 per cent under such conditions.

3. The sludge can be readily removed from the tank by means of a motor driven diaphragm pump, and it can be rapidly dried on sludge beds. Analysis indicates a fertilizer value estimated at $3.50 per ton.

4. A further reduction in the residual oxygen demand of the tank effluent can be accomplished by aeration; preliminary tests indicating as much as 50 per cent.

5. Chemical treatment of pea cannery wastes without removal of the coagulated organic solids prior to mixing with municipal sewage does not materially lighten the burden imposed by such wastes on city sewage disposal plants.

6. The treatment will materially reduce objectionable stream pollution and prevent nuisances often caused by untreated pea cannery wastes.

7. The estimated cost of waste treatment for a two-line cannery is $13 to $15 per day of capacity operation.

Further investigations are contemplated for the coming canning season to develop practical control tests and methods in the operation of chemical treatment plants of pea cannery wastes, to determine the efficiency and practicability of aeration as secondary treatment, and to make comparative studies with other methods of cannery waste treatment being experimented with in other states. Research is suggested in regard to utilization of some of the pea-canning wastes, particularly the silage juice and blancher wastes, because of the considerable amount of carbohydrate present in them.

Acknowledgment is herewith made of the activities of C. M. Baker, state sanitary engineer of Wisconsin, in making possible the experimental work described in this paper. The excellent cooperation of W. E. Nicholoy, executive secretary, and other officials of the Wisconsin Canners' Association, assisted materially in conducting the investigation. The willing help of M. Starr Nichols, chief chemist, State Laboratory of Hygiene, and J. P. Smith, assistant sanitary engineer, greatly facilitated the analytical work in the laboratory and in the field, respectively. The courtesy of the National Lime Association and American Steel and Wire Company in furnishing the lime and ferrous sulfate aided considerably in reducing experimental costs.

EFFECT OF PARTICLE SIZE ON THE HYDRATION OF LIME

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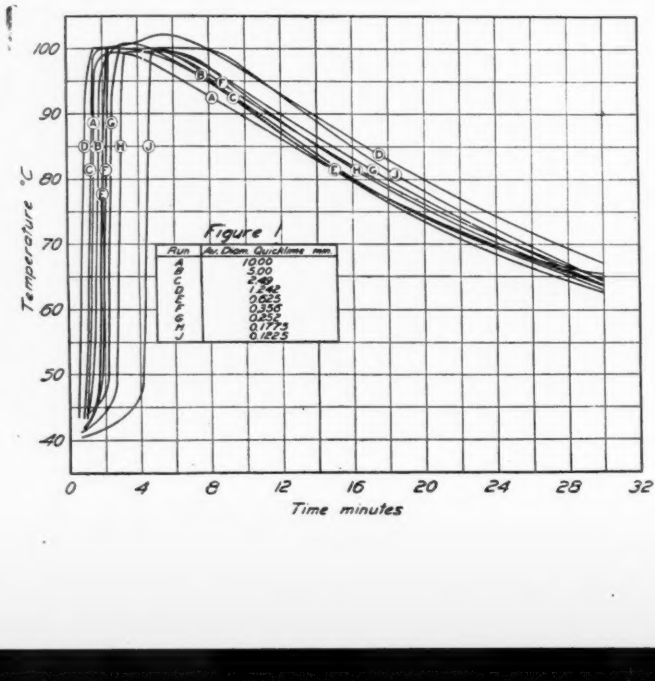
IT IS well recognized that method of hydration of a quicklime plays an important role in determining the properties of the hydrate. Thus Whitman and Davis, using a high-calcium quicklime, have shown the effect of various amounts and temperatures of water and water vapor on some of the properties of the resulting hydrates. Briscoe and Mathers have discussed the effect of these factors, particularly as regards plasticity, on the hydration of dolomitic limes as well as the effect of adding alkali chlorides. The present commercial methods of hydration involve treatment of quicklime with sufficient water to maintain the temperature of hydration around 100 degrees Cent., at the same time yielding a relatively dry hydrate. This paper reports a study of the effect of diameter of particle of quicklime, slaked with an amount of water to yield a hydrate of low moisture content, on the properties of the hydrate.

A sample of an eastern high-calcium lump lime was crushed and screened, yielding nine fractures varying in average diameter between 10 and 0.1255 mm. Care was taken to prevent segregation as far as possible by carrying a lump of lime to the desired mesh with the minimum possible production of fines. The samples were placed in air-tight cans and sealed for subsequent hydration.

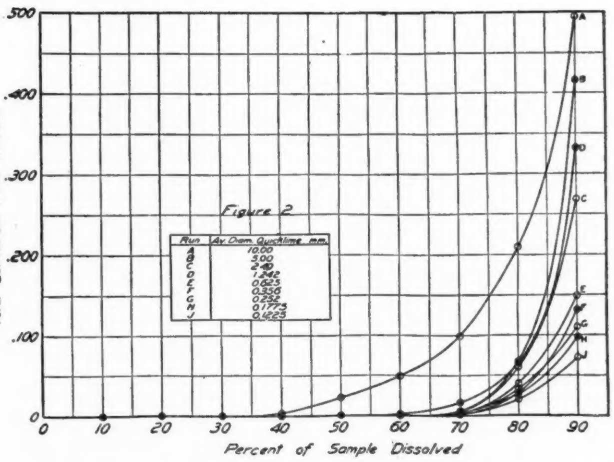
The hydrator consisted of an 8-inch capped section of 4-inch bronze pipe, set on its vertical axis, the charge being agitated by a stirrer revolving at 21 r.p.m. It was found that very satisfactory mixing could be obtained in this apparatus. Provision was made in the cover for the addition of the quicklime and the steam generated was freely vented. In order to follow the progress of hydration, a thermocouple was soldered into a hole drilled in the side of the hydrator and calibrated by filling the hydrator with water and noting its temperature with a thermometer. A series of preliminary runs was made to determine the amount of water necessary to obtain a low moisture content of hydrate.

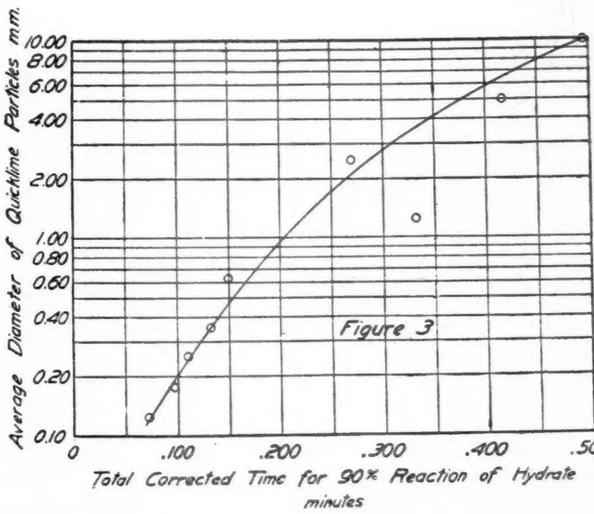
In making a run 250 grams of quicklime were poured into the hydrator, which contained the amount of water calculated to produce a dry hydrate. Temperature readings were obtained by means of a millivoltmeter during the course of hydration. At the beginning of a run the temperature of the hydrator was always brought to 43 degrees Cent. and the quicklime and water were brought to a constant room temperature of about 25 degrees Cent. The run was considered complete at the end of 30 minutes, when the stirrer was stopped and the hydrate removed. The hydrate was placed in a sealed bottle and allowed to ripen for at least 3 days before any tests were made on it.

Each sample of hydrate was tested for moisture content, rate of reaction with hydrochloric acid, settling rate, plasticity, and putty volume. Moisture content was determined by drying a sample to constant weight in CO_2-free air at 115-120 degrees Cent. Whitman and Davis have used the time of reaction of a hydrate with successive portions of hydrochloric acid as a measure of the particle size or reactivity of the hydrate. Thus a weight of sample (3.7 grams) sufficient to react completely with 100 cc. or normal hydrochloric acid was titrated with successive 10-cc. portions of normal acid. The time required for the return of the pink color of phenolphthalein was noted after each addition. These times were then corrected to show the time which would be required for normal acid to react with the sample, by multiplying by the normality of the acid calculated at each addition. Thus to a 3.7-gram sample 10 cc. of water were added, and after the sample was completely wetted 10 cc. of acid were added and the time for the return of pink noted. This time was multiplied by the normality of acid on the sample at the start—i.e., 0.5; similarly, after the next 10-cc. addition of acid a factor of 0.33 was employed. From these data the total corrected time of reaction was calculated for each 10 per cent of sample dissolved. Since reaction time is proportional to particle diameter, the total corrected time gives a measure of the average particle size for each 10 per cent of sample. The



*Presented before the Symposium on Lime, Richmond, Virginia, April 13, 1927.





settling rates were determined on a 10-gram sample of hydrate shaken up with water to a total volume of 100 cc. and allowed to settle in a 100-cc. graduate of approximately 2.75 cm. diameter. Readings were taken at frequent intervals during the settling. In determining the plasticity of the samples about 200 grams of hydrate were mixed with water to a thick putty, which was allowed to soak for 17 to 22 hours. The putty was then brought to a standard consistency and plasticity and putty volume determined by a Bureau of Standards method,

When quicklime is added to water with stirring, there is a preliminary period during which the particles of quicklime absorb water into the pores with very slight hydration occurring. This small amount of hydration raises the temperature of the lime particles to a point where an increase in temperature causes a rapid increase in the rate of hydration and a rupturing of the particles, the mixture of lime and water jumping to the boiling point. Here hydration proceeds at a greater or less rate dependent on the breaking up of the initial particles. Following this period of constant temperature, there is a period during which a small amount of hydration of any previously unhydrated lime may take place, but at which the heat losses by radiation from the hydrator exceed the heat evolution due to hydration, causing a falling off of temperature. Finally, the temperature drops more rapidly owing to the cooling of the hydrator by radiation and convection to the surroundings. The temperature changes during the hydration of the various samples are shown in Figure 1, where temperature is plotted against elapsed time from the beginning of the addition of lime to the hydrator. It will be seen that as the size of quicklime particle is decreased to 1.242 mm. average diameter (run D), the wetting of the particle takes place more rapidly and the beginning of hydration is advanced. However, if we go beyond this point a decrease in the particle size causes a slower wetting and a delayed start of the hydration.

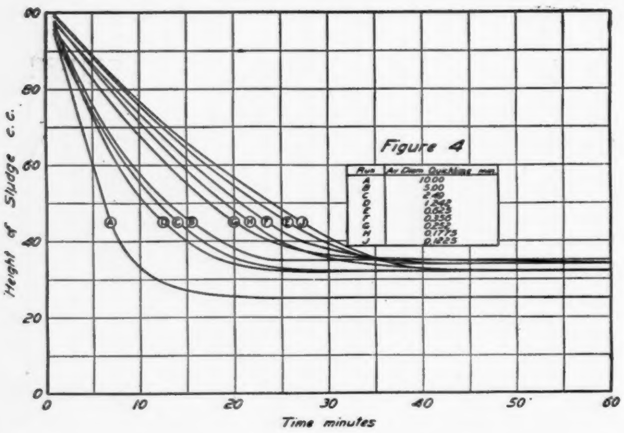
An examination of the hydrates formed showed that in the runs using the larger sizes of particles (2.49 mm. and above) some particles of quicklime, which had not reacted during the hydration and subsequent ripening, remained. The presence of unhydrated particles where the smaller diameters of quicklime particles were employed was not noticeable. The hydrate produced in run D was found to contain 0.21 per cent of free lime; the remainder of the samples, however, had a low content of free moisture (Table I).

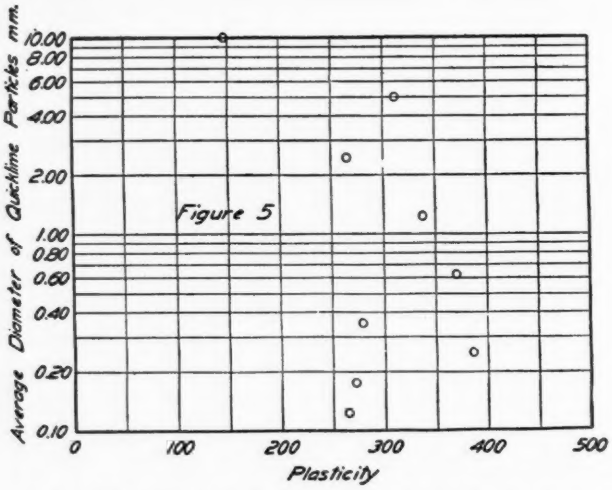
TABLE I.

Run	Av. Diameter of Quicklime Particles Mm.	Moisture in Hydrate Per cent	90% Reaction Time Minutes	Distance Settled in 15 Min. Cm.	Plasticity	Putty from 100 Grams Hydrate Cc.
A	10.00	5.20	0.495	72.8	147	137
B	5.00	1.21	0.416	54.0	312	175
C	2.49	2.40	0.269	56.2	265	160
D	1.242	—0.21[a]	0.332	59.2	338	172
E	0.625	0.76	0.149	35.7	370	171
F	0.356	1.29	0.132	38.2	279	164
G	0.252	0.92	0.110	45.0	386	180
H	0.1775	2.99	0.097	41.2	272	155
J	0.1255	5.36	0.072	34.0	265	156

[a] Indicates 0.21 per cent of free CaO in hydrate.

The distribution and magnitude of particle size of the hydrates may be measured by obtaining their reaction time with hydrochloric acid as outlined above. The total corrected time has been plotted against the per cent of sample dissolved in Figure 2. It has been shown that the rate of solution of a solid is inversely proportional to the diameter of the particle; hence, as particle size increases the time required for solution is correspondingly increasd. The rate of reaction curve gives a measure of the percentage of particles above a given size; for example, hydrate A contains 30.5 per cent of particles which are incompletely dissolved in 0.10 minute, while sample D contains only 16.3 per cent of these particles. It is also possible to compare the average particle size of the various hydrates, as particle size will be proportional to total corrected time of reaction. Thus, hydrate A is 90 per cent dissolved in 0.495 minute, while hydrate D is 90 per cent dissolved in 0.332 minute. The ratio of these times, 0.495:0.332, is the ratio of the average particle size of 90 per cent of hydrate A to the average particle side of 90 per cent of hydrate D, and is equal to 1.49. The total corrected time at which 90 per





cent of the sample is dissolved is shown in Table I and is plotted in Figure 3 against the logarithm of the average diameter of quicklime particle. These points fall on a reasonably smooth curve in which reaction time decreases with decrease in size of quicklime particle. Thus, to produce a hydrate of small average diameter of particle a finely divided quicklime should be employed. It will be noted from Figure 2 that not only is the size of the largest particle considerably reduced, but the percentage of particles of a size so small that the reaction time is less than 0.005 minute is greatly increased. This does not, however, give a measure of the smallest particles present, and here one must turn to settling rates where one may study the particle distribution of the smaller sizes.

The distance settled in a given time by a solid particle decreases as the diameter of the particles decreases, and thus a measure of particle size may be obtained by plotting height of sludge against time of settling, as in Figure 4. As the larger particles of hydrate settle very quickly they are removed in less than a minute from the dividing line between clear supernatant liquor and sludge. This enables one to study the size of the smallest particles with ease. It will be seen that the curves group themselves in a manner similar to the grouping in Figure 2, although the order is not identical in any group. The distance settled in 15 minutes is given in Table I. It will be seen that in general the finer particles of quicklime give finer hydrate particles.

To produce a satisfactory finishing hydrate a plasticity well over 200 is desirable. It will be seen from Table I that with a particle diameter of quicklime of 10 mm., the low plasticity renders the hydrate unsuitable as a finishing lime. In all the other runs a plasticity figure of over 265 was obtained, although the plasticity figure apparently bears no direct relation to the particle size of the quicklime from which made (Figure 5). The higher plasticities occur at a particle size between 0.252 and 1.24 mm. diameter. As might be expected, putty volume follows plasticity, showing that increase in the latter is largely due to the increased water-carrying capacity of the hydrate. The two runs on the smaller sizes of particles, although yielding satisfactory finishing hydrates, do not attain the highest plasticity figures. It is evident that a high plasticity is not the result entirely of fineness of particle, but that there is undoubedly a distribution of particle size in the dry hydrate which after soaking produces a putty of maximum plasticity. Thus hydrate B has about twice the percentage of particles of reaction time greater than 0.07 minute that hydrate J possesses; moreover, its finest particles are much coarser than those in run J, as shown by the relative distances settled in fifteen minutes. Nevertheless, the plasticity of a putty from hydrate B is 312 compared with a similar figure of 265 for hydrate J.

Conclusion

It has been found that in the hydration of a high-calcium lime the size of hydrate particles may be decreased by decreasing the diameter of the quicklime particles. Thus, a finely ground quicklime will yield a more reactive hydrate, possessing a lower settling rate. While a quicklime particle of 10 mm. average diameter yields a hydrate with the low plasticity figure of 147, indicating an inferior hydrate, by reducing the size of the quicklime particle to 5.0 mm. and below, the product may be classified as a finishing hydrate, plasticity values running between 265 and 386. The putty volume is found generally to follow the plasticity figure, varying between 137 and 180 cc. from 100 grams of hydrate.

Artificial Stone

Plastic compositions containing magnesium chloride and siliceous matter are poured or pressed into moulds having perfectly smooth surfaces of glass or other material, whereby articles presenting a vitrified appearance are obtained. According to an example, a pulverized mixture of 140 parts of a micaceous schist, 51 parts of magnesia and 9 parts of coloring matter is kneaded with an equal amount of magnesium chloride solution at 24 degrees Bé; the mixture is pressed in a glass-bottomed mold and left to set for three days. V. Aerni (British Patent 266,364).

LIME PROBLEMS IN BEET SUGAR INDUSTRY

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THE production and consumption of quicklime in the beet sugar industry of the United States amounts to approximately 200,000 tons annually. Less than half of this amount is converted directly into calcium hydrate to be used as "milk of lime" in the purification of raw juices. The larger portion serves a dual purpose in factories equipped with the Steffen process. Here it is first ground to a fine powder to be used as a precipitant in the recovery of sucrose (as a sucrate of lime) from beet molasses. Subsequently a water suspension of this precipitate is employed for the same purpose as the calcium hydrate. Thus the beet sugar industry encounters its "lime problem," the magnitude of which is probably considerably larger than is generally realized.

This problem relates to the production, at a minimum cost, of (1) a lime containing a maximum content of active calcium oxide and (2) a lime which may be readily ground to produce a reagent most suitable for the Steffen reaction. The former, involving equipment capacity, fuel consumption, source of raw material, and methods of manipulation, is largely identical with that problem universally met by lime producers. The latter is, obviously, more specific to the beet sugar industry. This paper pertains to certain fundamentals underlying the production of lime for use in the beet sugar industry as they have been worked out within the industry.

Although it is a factor of prime importance in the control and capacity of kilns—as well as, possibly, in the quality of product—little has been published relative to the rates at which limestones decompose. Especially is this true as it relates to the conditions encountered in kilns of the shaft type.

Reviewing the fundamentals underlying this problem, there is the fact that the reaction involved is endothermic and, hence, heat must be supplied to the molecule if it is to be decomposed. Further, in the shaft kiln a group of molecules is encountered in the form of a lump of stone. Thus it would seem essential that any consideration of the mechanism by which, or of the rates at which, limestones are decomposed must involve the mechanism by which heat may be conveyed from the source of its production to the point of its consumption—the decomposing molecule.

It is generally accepted that heat may be transmitted by one of three processes—conduction, convection, or radiation. It would appear that in the shaft kiln, where coke is employed as a fuel, heat may flow to the face of the decomposing lump of limestone by any or all of these methods. After the outermost layer of molecules has been decomposed, however, the heat required for the decomposition of those not exposed on the surface of the lump must flow through a layer of lime. This part of its path must, it seems almost certain, be traversed by conduction.

Considering the fact that where high temperatures are employed the transmission of heat by radiation is usually much more rapid than by conduction, together with the probable fact that heat is conveyed to the face of the lump by all three processes acting simultaneously, it would seem that the delivery of the heat to the face of the rock might be much more rapid than its delivery through the layer of lime to the decomposing molecules by means of conduction alone. If this is true, then the controlling factors in the rate of decomposition of limestone in the lump form will be those which control the conduction of heat through lime.

The relationship between the factors involved in the process of transferring heat by conduction may be expressed algebraically by the equation

$$H = \frac{KA\ (t_1 - t_2)\ T}{D}$$

where

H = amount of heat transported
A = mean area of path traveled
D = mean length of path traveled
t_1 = temperature of hot end of path
t_2 = temperature at cooler end of path
T = time employed
K = coefficient of heat transfer

The temperature, t_2, at the cooler end of the path, in so far as we concern ourselves only with the heat required for decomposition, is the temperature of the decomposing molecule. Since the relation between the dissociation pressure of calcium carbonate and temperature is so well established, it would seem possible to estimate this temperature if it is possible to estimate the concentration of carbon dioxide in the atmosphere surrounding it.

The gas evolved through the decomposition of the molecule within the lump must pass from that point to the surface, probably by diffusion. Since a gas may diffuse only from a point of higher concentration to a point of lower concentration, the partial pressure of the carbon dioxide at the molecule must be somewhat higher than in the main body of the kiln gases at the face of the lump. However, when we consider that the rate of diffusion is proportional to the absolute temperature, that in kiln operation we are dealing with comparatively high temperatures, that the layer of lime is probably

*Presented before the Symposium on Lime, Richmond, Virginia, April 13th, 1927.

relatively porous, thus providing ample area for the path through which the gas may diffuse, and the relatively low rate at which the gas is evolved under usual kiln conditions, it would appear that the concentration at the point of liberation need not be materially above that in the main body of the kiln gases. Thus, it may be assumed, for the purpose of experiment, that the molecule in the interior of the lump will decompose at the temperature which would control were it in direct contact with the main body of the gases passing over the face of the lump.

If our previous deductions concerning the rapidity with which heat is transferred to the face of the lump are correct then the temperature drop between the source of heat and the face of the decomposing lump should be small and the temperature, t_1, of the cooler end of the path might be considered approximately the same as that of the gas passing over the face. Further, if the lump of limestone being decomposed is in the shape of a cube, one might expect the unburned "core" to be cubical, or approximately so, at any time during decomposition, provided that heat was delivered to all faces of the lump in equal rates. If this is true, it will be possible to calculate both the mean area, A, and the mean length, D, of the path traveled by the heat through the lime layer while the lump is being decomposed.

The coefficient of heat conductivity, K, for a given substance, is usually considered as a function of the temperature. Thus, for a lime it may be considered as a constant except for the effect of slight variations in the mean temperature of the path through which the heat is conducted. However, it might be expected that lime produced from a wide variety of limestones would vary appreciably in this respect. Further, if the conduction of heat through the layer of lime to the decomposing molecule is the controlling factor in the rate of decomposition, then the approximate rate might be expressed by the equation

$$\frac{H}{800} = \frac{KA\,(t_1 - t_2)\,T}{D}$$

in which the total heat delivered to the decomposing molecules, expressed in B.t.u., is divided by 800 B.t.u., the quantity of heat required to decompose a pound of calcium carbonate, to give the pounds of calcium carbonate decomposed under a given set of conditions, as expressed by the factors involved in the right-hand term of the equation.

Laboratory investigations designed to check this line of reasoning have not been completed, but the results obtained thus far indicate certain conclusions which are of interest. Experimental—Limestone from only one quarry and carefully selected from one point in the quarry was employed. This stone was sawed into cubes varying in size between 2 and 4 inches (5 and 10 cm.) on the edge. These cubes were burned in a reverberatory type furnace (hearth size approximately 16x22 inches) heated with gas. With the aid of specially designed pedestals made of fire clay, with a V-shaped groove in the top face, it was possible to place a cube in the furnace with one edge resting in the V, so that approximately 95 per cent of its surface was exposed to receive heat from the products of combustion and from the furnace walls.

By metering the gas and air required for combustion, the concentration of carbon dioxide in the combustion products was maintained constant, within reasonable limits, throughout the period of burning. By means of a continuous recording instrument the carbon dioxide content of the gases in the combustion chamber was measured throughout the period and, as will be understood, the difference between that produced by combustion and that recorded as present represented that evolved through the decomposition of the calcium carbonate. It was thus found possible to follow the progress of, and to estimate the time required for, decomposition by observing the curve.

To supplement this method, it was customary to bring the experiment to an end somewhat before decomposition of the cube was complete, measure the size of the core, and employ the factors A and D, thus determined, in the calculation of results. The temperature of the furnace was measured by means of a thermocouple and continuously recorded by a suitable instrument.

The operation consisted of charging the cold furnace with cubes, the number varying with the size, and bringing the temperature gradually to the desired point. As the temperature reached the point at which the outer layers of molecules decomposed, a perceptible break in the recorder curve appeared. This break, usually occurring at a point between 775 and 800 degrees Cent., indicated that heat was being consumed for decomposition faster than it was being delivered to the face of the lump, and was useful in determining the time at which decomposition began.

From this point both the temperature and the amount of carbon dioxide evolved increased, the former rising to the predetermined point desired in the experiment and the latter to a maximum. As a rule the maximum carbon dioxide concentration was approached somewhat before the temperature had reached the desired point, indicating increasing resistance to the flow of heat to the point of decomposition. This maximum concentration was usually reached when a layer of lime 1/8 to 1/4 inch thick had been formed. The curve indicated a decreasing rate, gradually approaching, as a limit, the line representing that concentration of carbon dioxide resulting from combustion. The shape of this last portion of the curve corresponded very closely to that which would be expected if the rate of conduction of heat through the lime layer were the controlling factor.

The experiments showed definitely that the shape of the unburned core was cubical, with the corners and edges only slightly rounded and with a slight tendency toward pitting on the faces.

The results of the experiments thus far completed indicate that the time required to decompose a given size of cube of this stone is directly proportional to the factor $(t_1—t_2)$, the deviation being less than ± 15 per cent. They further indicate that the time required for decomposing cubes of various sizes (2, 3, and 4 inches on the edge), when employing a constant temperature difference $(t_1—t_2)$, is directly proportional to the square of the edge (or the surface area of the cubes). Thus, if a 2-inch (5-cm.) cube required 4 hours for decomposition, a 3-inch (7.6-cm.) cube would need 9 hours under the same conditions of temperature and carbon dioxide concentration. Here, again, the deviation was less than ± 15 per cent. The press of other work caused the abandonment of the investigations more than two years ago. At present, there seems but little possibility of resuming them in the near future. By publishing at this time it is possible that others may find something of interest in it or find means to carry it to conclusion.

It might also be mentioned that the application of these conclusions to the operation of the twenty-seven kilns employed in that branch of the industry with which the writer is associated has resulted in increased kiln capacity and a general reduction in coke consumption. One kiln, into which stone varying from 1 to 2.5 inches in size was charged for a period of 100 days during the last year, consumed less than 7.5 per cent coke on rock as compared with more than 10 per cent during like periods in previous years with stone varying from 4 to 8 inches, the daily capacity being maintained approximately constant during all periods.

A problem more specific to the beet sugar industry—a method which has been developed to determine the quality of the lime powder to be used in the Steffen process—may also have some general interest in that the fundamentals involved are probably related to those generally encountered in the employment of lime as a chemical reagent.

The reaction involved in the Steffen process is usually written

$$3CaO + C_{12}H_{22}O_{11} \rightarrow 3CaO.C_{12}H_{22}O_{11}$$

It is probable, however, that two reactions are involved, the first action producing the soluble sesquicalcium sucrate

$$3CaO + C_{12}H_{22}O_{11} \rightarrow 3(CaO.C_{12}H_{22}O_{11})$$

to yield the insoluble compound generally termed "tricalcium saccharate."

As would be expected, all the CaO in a lime powder is not available as a reagent in these reactions, and it is therefore necessary to estimate the "available calcium oxide" in a suitable manner. For this purpose a method involving titration with iodine was employed. Eighteen samples of commercial lime powders were collected from nine factories (two samples from each of seven and three from each of two) employing rock from four quarries located on the eastern slope of the Rocky Mountains in Colorado and Wyoming, and tested as above indicated. The results are given in Table II, column 2.

The mechanism by which these reactions proceed, and probably that involved in many other reactions employing lime, undoubtedly follows the general law for "heterogeneous reactions" as developed by Noyes, Whitney, Nernst, and others. Thus, the area per unit weight of the reagent, lime, influences materially the rate at which the reaction proceeds or, on the other hand, the quantity of reagent required to effect the reaction in a given time. This gives rise to the problem of measuring the area of the powder and also to that of producing a powder with the maximum area per pound. It has been customary within the industry to judge the fineness of this powder by screening through a 200-mesh sieve, good practice demanding that more than 98 per cent pass through the screen. Obviously, this did not provide an accurate measure of the actual fineness of the powder.

Experimental.—In the laboratory investigation of this subject, hydraulic classification, employing "free settling" of the lime particles in a medium of anhydrous kerosene and a series of inverted cones similar to a Spitzkasten, was applied. The series included six cones of such sizes that, with a given rate of flow of kerosene, spherical particles of lime having a diameter of more than 0.06 mm. would be collected in the first unit, those measuring less than 0.06 mm. and more than 0.05 mm. in the second, larger than 0.04 mm. in the third, larger than 0.03 mm. in the fourth, larger than 0.02 mm. in the fifth, and larger than 0.01 mm. in the sixth, while those smaller than 0.01 mm. would be collected on filter paper by filtering the overflow from the last cone. The rate of flow of the kerosene was governed by means of an orifice and a constant-head tank feeding it. The rate employed was determined by microscopically measuring the size of particles found in the various fractions and, adjusting until the desired separations were obtained, was the same for all powders tested. Care was taken to insure free-settling conditions by so designing the tanks that, for the weight of sample employed, the ratio of kerosene to lime would exceed 20 to 1 at all times. Evidence of errors due to agglomeration of particles was practically nil.

In the course of the work it was found necessary to estimate the mean size of the fraction collected on the filter paper, as it occasionally comprised as much as 25 per cent of the total. This was done by microscopic measurement.

Eighteen samples, each containing less than 2 per cent by weight of material which would not pass through a 200-mesh screen (opening 0.065 mm.) when subjected to this test, gave results, in terms of square centimeters per gram of available CaO calculated on the basis of spherical particles, as shown in Table I.

Table I—Determination of Specific Surface of Lime Powder.

Sample	Number of Detns.	Area Sq.cm./gram	Variation from Average Sq.cm./gram
1	1	3220	...
2	3	2820	±1.1
3	3	3110	5.0
4	1	3060	...
5	1	2910	...
6	2	2910	0.3
7	2	2730	1.7
8	1	2850	...
9	3	2670	3.0
10	1	2630	...
11	2	2700	1.0
12	3	2660	7.7
13	3	2440	6.0
14	3	2520	5.1
15	2	2460	5.5
16	2	2450	2.0
17	1	2460	...
18	1	2330	...

The amount of active (available CaO) reagent required to precipitate 90 per cent of the sucrose in a diluted molasses solution containing 5.5 per cent sucrose (on solution) in a given time and under carefully maintained conditions of temperature, degree of agitation, rate of reagent addition, etc., should be, according to the Noyes-Whitney law, a fraction of the area per unit of weight. Larger quantities of the coarser powders would thus be required. These samples were further tested as precipitants for sucrose in laboratory apparatus which provided accurate control of precipitating conditions, and results obtained as are shown in column 4 of Table II.

It is apparent from these data that a definite relation between the area per unit weight of powder and the effectiveness of the reagent does exist and that the amount of reagent required varies inversely with variations of the former.

If it is assumed that the amount of reagent required is inversely proportional to the area per unit weight of the powder, and if the arithmetical average of the amounts and areas determined in these tests is used as a basis for calculating a proportionality constant, the equation

$$\text{Available CaO required} = \frac{2180}{\text{sq. cm. per gram available CaO}}$$

may be formulated. By using the area as given in column 3 of Table II, the quantity of reagent required may be calculated—and the data given in column 4 were thus obtained. It therefore appears that the amount of reagent is inversely proportional to the area per unit weight and that this factor is probably the largest variable affecting the quality of the reagent, with the "available CaO" content of second importance in the samples concerned.

Table II—Precipitation Tests.

Sample	Available CaO Per Cent	Area Sq.cm./gram	CaO Required per 100 Sugar in Solution By Test	Calcd.	Variation
1	84.6	3220	68	68	0
2	84.0	2820	71	77	—6
3	87.5	3110	72	70	+2
4	87.6	3060	74	71	+3
5	87.3	2910	75	75	0
6	87.0	2730	75	80	—5
7	85.0	2910	77	75	+2
8	88.1	2850	78	77	—5
9	82.3	2670	81	82	—1
10	83.7	2630	82	83	—1
11	91.4	2660	82	82	0
12	84.9	2700	84	81	+3
13	90.6	2440	84	89	—5
15	88.5	2460	84	88	+4
14	83.8	2520	85	86	+1
16	88.6	2450	88	88	0
17	86.8	2460	89	88	+1
18	86.7	2330	95	94	+1
Average		2718	80.2		

Obviously, by using standardized solutions of molasses and standardized apparatus to determine the amount of a reagent needed to effect a given precipitation, the above relation may be used to estimate the "area per unit weight" factor with sufficient accuracy for the control of commercial operations.

The factors entering into the problem of producing a lime powder with suitable area remain untouched in a research way, although an investigation is planned for the near future. That a problem exists is evidenced by commercial experience wherein considerable variations in the "grindability" of the lime are encountered. The Raymond mill, with the usual closed-circuit air-classification arrangement, is employed for grinding in all cases and the maximum output per unit of equipment at the different factories varies as much as ± 50 per cent when producing powders of equal specific surface. It would appear at this time that grindability may be a function of either the source of raw material of kiln manipulation or possibly of both, with the raw material exerting the greatest influence.

National Sand and Gravel Association to Hold Chicago Meeting, June 29th

The board of directors of the National Sand and Gravel Association will meet in Chicago on June 28 at the Palmer House at 10 o'clock in the morning. At the same time on June 29 there will be an open meeting of all members of the association. The board of directors will select the place and date of the 1928 convention of the association at its meeting. Plans concerning the expansion of the research activities of the association will also be considered.

PIT & QUARRY FOREIGN DIGEST

Porous Plaster

Gypsum which is partly dehydrated but which contains more water than plaster of paris is mixed with a substance which evolves gas when the mixture is gauged with a dilute acid, thus producing pores as the mixture sets. Calcium or other carbonate may be used as the gas-generating substance, or an impure gypsum rich in calcium carbonate may serve as raw material. Hydrochloric acid is preferred, but several other acids are stated to be suitable. The mixture may be cast in molds which are covered with a sheet of porous fabric to permit the escape of the gas. Reinforcements may be used in the manufacture of the slabs or other forms, and they may be provided with an impermeable facing layer of cement, mortar, etc. G. O. Case (British Patent 266,524).

Drying Equipment

Drying tunnels of the latest type with the air passing in opposite direction to the material are now being constructed. One of these is an arrangement of 10 tunnels with common firing and use of direct heating gases. The material to be dried is placed upon a wagon fitted with shallow pans. In a drying tunnel with air heating, the heating surface in the form of ribbed tubes lies under the drying tunnel, and the material to be dried is carried on wagons run on overhead tracks. Anon. (Zement, April 21, 1927, pp. 318-320).

Treating Cements

Hydrated oxides of iron of aluminum are added to hydraulic cements or mixtures containing them to increase strength and to prevent efflorescence. The residue from the extraction of alumina from bauxite is particularly suitable as an addition. The invention is particularly applicable to the manufacture of asbestos-cement products. The use of other hydrated oxides having a weak acid reaction, such as reactive forms of silica, is also described. A. E. Hills (British Patent 266,775).

Cast Stone

The reconstruction of some of the central districts of London, England, combined with the increased costs, has caused architects to look beyond the materials which they have become accustomed to specify automatically, and cast stone is one of the "discoveries" that have resulted from the search for something that is in all respects the equal of usual materials but cheaper. The modern cast stone, which is simply natural stone crushed and reconstructed with Portland cement so that it may be shaped by the less expensive method of moulding instead of cutting, is gaining in favor with leading architects with a reputation for conservativeness. So far as its wearing qualities are concerned, the material is, of course, of too recent date for comparisons to be made with natural stones erected centuries ago, but some of the earliest cast stone made in this country (England) is still in excellent condition. Examples of natural and cast stone erected thirty years ago compare so well and the two have weathered and blended together so that it is quite impossible to distinguish the one from the other from their appearance. (Concrete & Const. Eng., April, 1927, pp. 234-35.)

Production of Fused Cement from Reduction Slags

Assuming the case where a slag is available of something like the following composition: SiO_2, 10 per cent.; Al_2O_3, 34.5 per cent.; CaO, 55.5 per cent, if this slag is fused with the addition of 10 per cent iron oxide calculated on the total weight, a fused cement results which has a composition like the following: SiO_2, 0.1 per cent; Al_2O_3, 31.3 per cent; CaO, 50.5 per cent; Fe_2O_3, 9.1 per cent. It is possible that a small part of the iron exists as iron oxide. The amount of iron oxide used must be adjusted to give the desired results. W. Kyber (German Patent Application number 97,912).

Artificial Stone

Forsterite (magnesium olivine) is obtained by fusing a more acid magnesium silicate or silica itself with the magnesium salt of an acid (other than sulphuric) liberated by silicic acid in the heat. Magnesium carbonate is particularly suitable. Fluxes may be added, or the fusion may be commenced with a more fusible mixture such as quartz and magnesium sulphate. The process is also applicable to an equimolecular mixture of calcium and magnesium salts yielding diopside as product. J. Jakob (British Patent 266,789).

The Effect of Heating Inorganic Oxides with Aluminous Silicates

When dry strontium oxide is mixed with various aluminum silicates and the mixtures heated for five minutes at 600 degrees Cent. and then analyzed, it was found that large amounts of the silicates underwent transposition. Nephelin, orthoclase and leucite begin to react at about 435 degrees Cent. Litharge (PbO) was used in place of strontium oxide and heated with nepheline, leucite, orthoclase, etc., and displaced the alumina to the extent of 4-6 per cent at 600 degrees and up to 27 per cent at 710 degrees. Lead oxide and alumina combine when heated together to form lead aluminates, especially in the neighborhood of 900 degrees Cent. B. Garre (Zement, April 14, 1927, pp. 290-292).

Use of Fluorspar in the Cement Industry

Fluorspar increases in a straight line relation the fluidity of silicate cement clinker. This increased fluidity occurs in all technical processes more in evidence than in the lowering of the freezing point, especially when the addition is so regulated as not to exceed a new eutectic. It may be concluded that addition of fluorspar facilitates the sintering. On cooling clinker containing no CaF_2, the fluid phase disappears at 1270 to 1300 degrees Cent. Fluorspar clinker must be cooled more rapidly than the normal portland cement clinker. Fluorspar is used up to 5 per cent of the weight of the clinker. In spite of the lowering of the sintering point by such addition no definite proof of a deleterious influence upon the characteristics of the cement formed has yet been found. H. Becker (Zement, April 21, 1927, pp. 305-308).

New Developments in Construction of Reinforced Concrete Masts

There are three types of masts used for conveyance of electrical power. The first, built for voltages of 100,000 to 380,000, are almost entirely truss work steel masts. The second group consists of supports for lines carrying 20 to 60,000 volts. The third group supports lines carrying up to 20,000 volts and are usually impregnated wood but are being replaced by concrete. Kisse (Zement, April 21, 1927, pp. 311-317).

German and English Cement Testing Sieves

The English sieve number 180 contains 180×180 or 32,400 meshes per square inch or 5,022 meshes per square centimeter. The mesh spaces measure 0.0038 of an inch (0.097 mm.). Per linear inch there are 180 wires with a diameter of 0.0018 inch (0.046 mm.). The number of wires to the inch must not be greater than 182 or less than 178. The open space of a mesh should not be more than 0.0050 inch (0.127 mm). The wire thickness should not be smaller than 0.00171 inch or greater than 0.00189 inch.

The German 4,900 mesh sieve has the following standards: Open sieve spaces (1) 0.088 mm. Diameter of wire (d) 0.055 mm., open area per unit of surface $= \frac{1^2}{(1+d)^2} \times 100 = 36$ per cent. 5 per cent deviation is permitted as an average with 10 per cent as the maximum individual departure. The tests, made at a magnification of 703 times and at 53 times, as well as by sieving the same meal and weighing the residue, showed that due to the thicker wire used in the German sieves the residue was always less and the deviation from the standard also less in space and diameter dimensions. Dr. Haegermann (Zement, April 14, 1927, pp. 289-290).

The Setting of Calcium Sulphate Dihydrate

The hydration of the natural and artificial anhydrides, the latter formed by the ignition of $CaSO_4.2H_2O$ at 400 to 700 degrees Cent. with the aid of various materials—acids, acid and neutral salts, and bases—was investigated. The accelerating effect of these substances can be explained by the assumption that $CaSO_4$ is capable of forming complex compounds. In all probability the anhydride, in the presence of water and salt, forms unstable complicated hydrates upon its surface—(salt) . $MCaSO_4$. N_2O. The unstable hydrate thus formed decomposes subsequently according to the formula:

$$(\text{Salt}) \,.\, mCaSO_4 \,.\, nH_2O \longrightarrow (\text{Salt}) \,.\, H_2O + CaSO_4 \,.\, 2H_2O.$$

After the first process of hydration, follows the second—the setting. The setting cannot be explained only by the hydration, as recrystallization plays an important role. In many cases the cement attains a decided strength while only a slight hydration has occurred. With increasing fineness of division the affinity for water increases. This fineness may be less with acid than with neutral salts. The more thoroughgoing the hydration, the more observable is the recrystallization and the harder the cement obtained. P. P. Budinkoff (Zeitschr. f. Angew. Chemie, April 7, 1927, pp. 408-409).

Crystallization of Aluminous Cement

The mechanism of the crystallization is dependent upon the fact that anhydrous calcium aluminate is much more soluble than the hydrated aluminate. It has been found that aluminous cement agitated with water for one hour gives a solution of calcium aluminate of about 3 grams per liter, whereas the solubility of the hydrated aluminate is only one-tenth of this value. A super-saturated solution is thus formed from which crystallizes, little by little, the hydrated salt. (Le Chatelier-LeCiment, March, 1927, 82-85.)

Treatment of Slip

Slip is treated by heating it with water, in the manufacture of cement, so that it absorbs the former and hardens, but it is cooled before it absorbs so much water that it sets and hardens. Allis-Chalmers Mfg. Co. (German Patent 440,972).

Rotary Kilns

A rotary kiln for treating cement is formed internally with annular projections which are spaced at least a distance apart equal to diameter of the kiln, so as to cause the material to spread along a succession of substantially horizontal planes. O. Bouzin (British Patent 266,939).

INTIMATE NEWS OF MEN AND PLANTS

Ottumwa Sand Company Completes New Plant

The Ottumwa Sand Company, Ottumwa, Iowa, has during the past winter completed a new plant, its material being dredged from the bed of the Des Moines river by 8 inch centrifugal American Manganese Steel pumps, driven by a General Electric 150 horsepower motor, mounted on a steel barge with direct pipe line to the washing plant. The discharge is directly into an old American Manganese pump shell, which retards the velocity, water and material dropping through the opening, into a Gilbert 26 inch conical screen, manufactured by the Stephens-Adamson Company. This screen removes the oversize. The rest of the material is directed to a 40 inch by 14 foot Telesmith rotary screen with ⅝ by 1 inch openings. The screen is provided with a sand jacket with 3/16 inch openings.

Sand from 3/16 inch down is spouted to a Good Roads sand washer which automatically loads the sand directly into cars. Gravel from 3/16 to ⅝ inch is directed to an Eagle gravel washer and material from 1 inch to 2 inch is taken to another gravel washer of the same make. Gravel from the washer is spouted into a bucket elevator, of the company's own construction, to the top of the gravel bins and there discharges into a rotary screen with ¼ inch perforations. Gravel passing the ¼ inch and retained on the 3/16 can be either diverted into a separate bin or back to the sand wash. In the latter case it is again mixed with the sand and used for concrete purposes to meet the requirements of the Iowa specifications. The spouts under the gravel screen are so designed that it is possible to direct back to the sand washer all the gravel up to ⅝ inch or up to 1 inch, which permits the making of road gravel or a mixture for commercial concrete. In order to reduce the volume of water entering the large gravel screen a 3/16 inch perforated plate is placed in the sluice from the over-size cone screen to the gravel screen. This plate removes the proper amount of water and what sand the screen will accumulate, sluicing this direct into the sand washer. Washing water is furnished to the gravel washer by a 5 inch Dayton-Dowd centrifugal pump with a capacity of 800 gallons per minute, directly connected to a 15 horsepower General Electric motor.

The driving mechanism for the entire plant is of the roller chain type, furnished by the Link-Belt Company. The Ottumwa Sand Company is now operating two plants, the second being of similar construction as the one described and also using methods of loading the material similar to those of the new plant, which is found to be very economically operated in producing an excellent quality of material.

James With National Guard

U. N. James, of the sales department of the National Cement Company, has been appointed property and disbursing officer of the Alabama National Guard with the rank of major. For some time past Mr. James was adjutant of the 167th Infantry with the rank of captain. The new office requires his full time and he has given up cement work for the time being. Major James began his new duties on April 18 and is now at Montgomery.

Pioneer Now Largest Gypsum Plant

The first manufacture of gypsum in the United States, it is reported, was not until 1832, when J. B. King set up a kettle in his backyard on Staten Island, New York, the gypsum rock coming from Nova Scotia. King made only enough plaster in his kettle to finish the interior of a house he was building. Curiously enough, on the site of King's backyard kettle there stands today a large gypsum manufactory which supplies gypsum and allied products to metropolitan New York and still uses rock brought from Nova Scotia.

It was not until after the World's Columbian exposition in Chicago in 1893 that gypsum plaster came into general use in the United States. At the Chicago World's Fair a majority of the buildings were covered on the outside with what is called "staff," which has gypsum plaster as its principal material. This use directed the attention of the nation to the unique qualities inherent in gypsum rock and any of its products—incombustibility, adaptability and ease of application.

With wider use of the material have come many improvements in the processes of manufacture. In contrast with the crude plaster J. B. King made in his backyard kettle in 1832, there are manufactured today many different kinds of gypsum plasters. There is, for example, gypsum plaster to be mixed with sand and water before application; plaster in which the sand already is mixed and that only requires the addition of water; plaster in which the sand is replaced by finely shredded wood fibers, and a special plaster for use over concrete.

New Plant in North Carolina

It has been reported that a cement plant is being planned at New Bern, North Carolina, to be financed by midwestern capital. Tentative plans are for the erection of a plant with an annual capacity of 1,250,000 barrels. J. A. Acker, of Port Huron, Michigan, with other representatives, recently visited North Carolina to investigate the possibilities of establishing a plant in the eastern part of that state.

Lime Plant Expands

A report says that the plant of the Port Byron Lime Association, at Port Byron, Illinois, which was operated last year under a receivership, has been acquired by the Fidelity Title and Finance Company of Davenport, Iowa, and operation has been resumed after necessary repairs under the superintendence of L. H. Trent. The plans of the company contemplate the installation of new and improved machinery.

New Sand and Gravel Plant at City Point, Virginia

We are informed that the sand and gravel plant of the Norfolk Sand and Gravel Company, located at City Point, Virginia, where a dock has been built on the James River, already has begun operation. The plant is not yet completed, but a small traveling steam shovel is being used to load a few cars while the big derrick that will form part of the plant is being erected. When the plant is completed it will have a capacity of twenty cars a day.

Will Develop Silica Deposits at Dennisville, N. J.

We are informed that a new company recently formed with Harry W. Hubbs, of Huntington, New York, as president, has purchased about 30 acres of land at Dennisville, New Jersey, which is reported to contain rich deposits of silica. A plant including two pulverizing and crushing machines, with a daily capacity of about 50 tons, as well as drying and bagging machines, will be installed.

Brownlee Park Company Uses the Hydraulic Method

The Brownlee Park Gravel and Material Company operates a plant east of the city of Battle Creek, Michigan, on the Grand Trunk Railway but provided with switch tracks to the Michigan Central Railway. This company uses the hydraulic method in stripping the overburden. A steam shovel is used in the pit to load the material into Industrial cars from the bank. The cars are then hauled by a steam locomotive to the plant, which is located about ¾ of a mile from the deposit.

The material is dumped into a receiving box and from there conveyed by a belt to the scalping screen. This removes the oversize stone which is conveyed to an Aurora jaw crusher. From this machine the material is taken by a conveyor to a belt conveyor which takes the crushed stone, together with the material below 2 inches, to the screen and washing plant. Here the material is graded and deposited into the respective bins.

Cars are loaded from the bins on one side and trucks are filled from the opposite side of the bins. The plant is operated by electricity. This company manufactures concrete blocks from the torpedo sand; plastering sand; mason sand and also torpedo sand for various kinds of work. Different grades of sand are also sold for use on the state concrete roads and also for reinforced concrete buildings which are constructed locally.

Ideal Sand and Gravel Co. Increases Production

A report says that the Ideal Sand and Gravel Company, whose plant is located northeast of Mason City, Iowa, which started its spring season with a production of six cars of sand and gravel a day, will soon begin shipping material to Charles City for the new pavement between that city and Nashua, when the capacity will be increased to 15 carloads a day. The gravel at the Ideal plant, which is lodged in what the geologists say is the old bed of Lime creek, is dug out and lifted into standard gauge dump cars by large excavators. These dump cars are hauled by steam locomotives to the hopper, to which the mixture is elevated by belt conveyors.

The raw gravel is first run through a two inch screen. Everything larger than two inches is run through the crusher. What goes through the screen is taken to the top of the screen house and washing plant. There it is run through screens to produce two grades of sand and four of gravel, as well as the various mixtures which are in demand. The finished product is loaded directly from the bins to the cars. As much as 2,600 gallons of water a minute is used to wash the gravel and sand in order to make a clean product and eliminate the possibility of foreign matter in the gravel. The Ideal Company supplies a territory within a radius of 100 miles of Mason City.

Miller Lime Incorporates

Mr. Clifford L. Miller, president, announces the incorporation of the Miller Lime Products Corporation, which on May 2 took over the operating control and management of the lime plant and quarries of Clifford L. Miller and the business hitherto done under that name in West Stockbridge, Massachusetts, and New York City. The objects of this change are to properly coordinate operating economies and to enlarge sales acquaintance with the trade in behalf of Miller West Stockbridge lime products. Active in this new organization will be Mr. Fred A. Daboll as vice-president and general manager, and Mr. Hugh McDonald as treasurer. The main office of Miller Lime Products Corporation will be at the plant in West Stockbridge, Massachusetts.

East St. Louis Company Installs New Equipment

The East St. Louis Stone Company, at East St. Louis, Illinois, it is reported, is about to install new equipment to increase its output of crushed stone from 3,500 to 4,000 tons daily. Mr. Ralph E. McLean, president and manager, who has been in the quarry business at this plant for the past 27 years, recently made arrangements in Chicago for additional financing to provide for the purchase of large crushers and other necessary machinery.

Plastint

The United States Gypsum Company has published a book describing the use of Plastint. This material is a colored finish plaster for obtaining rough texture wall finishes and is made in nine standard colors and white. Plastint is ready for use with the addition of water and is applied over the base coat of plaster. The uniform color of the wall is assured, as tinting is done with mineral colors ground in by machine at the mill. The book illustrates a number of different finishes and describes how each is obtained with this material, showing the several stages followed from the bare wall to the finished surface.

New Incorporations

Crystal Sand Co., Mission, Tex. $25,000. E. A. Showers, J. D. Brock, W. H. Wood.

Decatur Hydraulic Sand & Gravel Co., Decatur, Ill. $6,000. Wm. A. and Ida May Bowshier, 1405 W. Forest Ave., Decatur; Roy R. Wilson, 528 W. Decatur St., Decatur. Resumed operations.

Miller Lime Products Corp., Hudson, N. Y. $50,000. Clifford L. Miller, Claverack, N. Y.

Hudson Sand Co., Newburgh, N. Y. $50,000.

Lime Hydrate Co., 217 Broad St., Elizabeth, N. J. $125,000.

Ameriver Sand Co., Reno, Nev. 10,000 shares, $10 each; 200,000 shares, n. p. v.

Universal Sand & Gravel Corp., L. Oppenheimer, 60 Wall St., New York City. 100 shares com.

Oregon Lime Products Co., Portland, Ore. $100,000. A. A. Muck, Emily A. Muck, T. B. Neuhausen, Arthur I. Moulton. To engage in general mining. (Filed by Lord & Moulton, 1107 Spalding Bldg., Portland).

Christner Gravel & Construction Co., Goshen, Ind. $20,000.

Atlantic Gravel & Supply Co., Atlantic City, N. J. $50,000. C. C. Shinn.

Walling Concrete Products Co., Asbury Park, N. J. $125,000. Sand and gravel. Edgar R. Walling, Almira F. Walling, Daniel W. Taylor. (Attorney, Edwin P. Longstreet, Asbury Park.)

White River Materials Co., Hazelton, Ind. $25,000. Operate gravel pit. Charles A. Steele, Henry P. Phillips, Charles W. McFetridge, L. F. Sullivan.

Lone Star Gravel Co., Houston, Tex. $40,000. H. G. Bryan, T. F. Bryan, Mrs. Addie I. Bryan.

Sand Point Gravel Co., Seattle, Wash. $145,000. Albert E. Parker, C. L. Johnson, E. S. Parker.

Cement Co. Elects Officers

A report says that the Phoenix Portland Cement Company, Nazareth, Pennsylvania, at its annual meeting recently, elected the following directors: J. W. Walker, Philadelphia; Lindley C. Morton, Birmingham; C. L. McKenzie, Pittsburgh; Charles H. Cox, Philadelphia, and E. P. Haubert, Nazareth. The directors organized by electing the following officers: President, Lindley C. Morton; vice-presidents, J. W. Walker and C. H. Cox, Philadelphia, and R. J. Hawn, Birmingham; secretary and treasurer, E. P. Haubert; assistant treasurer, A. W. Nash. Reports showed that the company had a successful year, the ouput having been increased from one million to two million barrels.

DISTRIBUTION OF CEMENT

Portland cement shipped from mills into States in February and March, 1926 and 1927, in barrels*

Shipped to	February 1926	February 1927	March 1926	March 1927
Alabama	145,636	127,020	158,310	141,921
Alaska	264	132	917	305
Arizona	28,956	41,667	54,916	45,602
Arkansas	55,984	59,309	66,712	59,114
California	714,783	649,302	1,156,509	1,094,778
Colorado	51,068	45,006	81,623	47,912
Connecticut	29,323	58,534	78,962	109,035
Delaware	6,437	13,885	22,386	24,826
District of Columbia	47,086	59,964	63,249	95,396
Florida	445,674	285,604	402,888	290,682
Georgia	86,417	134,787	139,781	169,167
Hawaii	15,830	31,022	24,737	19,615
Idaho	19,524	27,495	42,131	35,047
Illinois	429,654	417,054	†570,121	752,148
Indiana	121,253	143,650	†190,063	267,288
Iowa	50,077	55,837	116,367	147,119
Kansas	114,296	107,823	182,003	166,110
Kentucky	56,249	78,183	†88,790	111,854
Louisiana	84,706	122,629	96,214	134,893
Maine	19,084	5,422	18,302	20,132
Maryland	77,537	123,421	132,720	231,780
Massachusetts	57,390	81,457	168,271	193,283
Michigan	253,661	301,666	†396,643	525,901
Minnesota	72,714	61,047	164,405	147,967
Mississippi	47,179	62,783	58,308	75,149
Missouri	202,914	173,365	332,104	287,825
Montana	9,867	9,845	17,203	19,365
Nebraska	49,054	39,594	121,456	81,860
Nevada	5,754	3,649	8,824	7,665
New Hampshire	12,750	9,599	18,043	25,391
New Jersey	163,588	279,739	424,812	611,542
New Mexico	14,308	20,957	18,594	32,564
New York	434,323	855,484	†1,026,903	1,511,091
North Carolina	139,656	168,720	271,422	235,316
North Dakota	4,905	3,081	23,260	20,429
Ohio	250,265	321,218	†420,536	576,334
Oklahoma	167,043	191,130	206,766	235,301
Oregon	58,991	53,310	117,611	91,820
Pennsylvania	351,940	476,001	†745,395	864,996
Porto Rico	0	1,275	0	2,500
Rhode Island	10,166	19,874	34,838	50,746
South Carolina	56,022	47,821	69,811	71,247
South Dakota	18,848	10,170	38,194	31,724
Tennessee	86,871	102,871	117,610	137,431
Texas	364,107	371,525	367,833	481,261
Utah	15,613	15,527	37,117	25,741
Vermont	1,640	4,472	5,052	9,397
Virginia	77,572	92,723	121,765	124,387
Washington	77,936	124,266	152,534	229,012
West Virginia	45,121	64,296	†89,108	97,058
Wisconsin	80,066	100,245	†155,840	221,345
Wyoming	11,710	7,754	12,225	10,293
Unspecified	20,827	18,914	†37,724	16,486
	5,762,637	6,682,134	9,467,908	11,017,151
Foreign Countries	57,363	48,866	71,092	65,849
Total shipped from cement plants	5,820,000	6,731,000	9,539,000	11,083,000

*Includes estimated distribution of shipments from three plants in February, 1927; from four plants in February, 1926; and from five plants in March, 1926 and 1927. †Revised.

Production, shipments, and stocks of finished Portland cement, by districts, in April, 1926 and 1927, and stocks of barrels in March, 1927

Commercial District	April Production 1926	April Production 1927	April Shipments 1926	April Shipments 1927	Stocks at end of April 1926	Stocks at end of April 1927	Stocks at end of March, 1927*
Eastern Pa., N. J. and Md.	3,258,000	3,640,000	3,679,000	4,163,000	5,311,000	5,154,000	5,677,000
New York	517,000	898,000	660,000	843,000	1,485,000	1,624,000	1,568,000
Ohio, Western Pa. & W. Va.	1,248,000	1,409,000	1,195,000	1,301,000	2,792,000	3,380,000	3,272,000
Michigan	762,000	1,056,000	610,000	963,000	1,931,000	2,068,000	1,975,000
Wis., Ill., Ind., & Ky.	1,400,000	1,552,000	1,550,000	1,623,000	3,816,000	3,277,000	3,348,000
Va., Tenn., Ala. & Ga.	1,260,000	1,354,000	1,311,000	1,385,000	1,059,000	1,147,000	1,178,000
Eastern Mo., Ia., Minn., & S. Dak.	1,134,000	982,000	1,142,000	977,000	3,078,000	3,231,000	3,226,000
Western Mo., Neb., Kan. & Okla.	854,000	964,000	899,000	791,000	1,443,000	1,757,000	1,584,000
Texas	411,000	469,000	447,000	491,000	501,000	425,000	448,000
Colo., Mont., & Utah	240,000	210,000	225,000	194,000	322,000	486,000	470,000
California	1,009,000	1,177,000	958,000	1,263,000	553,000	606,000	692,000
Ore. & Wash.	347,000	337,000	289,000	356,000	419,000	465,000	484,000
	12,440,000	14,048,000	12,965,000	14,350,000	22,710,000	23,620,000	23,922,000

*Revised.

Domestic hydraulic cement shipped to Alaska, Hawaii and Porto Rico, in March, 1927†

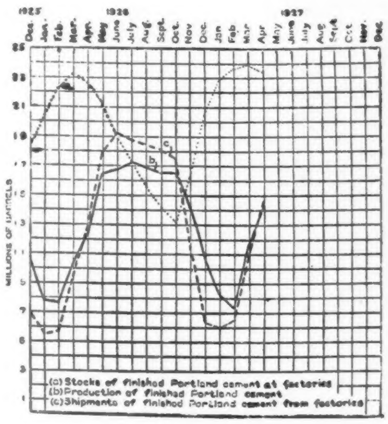
	Barrels	Value
Alaska	964	$ 3,023
Hawaii	29,548	65,965
Porto Rico	8,500	20,604
	39,012	$89,592

†Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

APRIL CEMENT STATISTICS

April production and shipments of Portland cement show increases, respectively, of nearly 13 and 11 per cent over the corresponding period in 1926, according to the Bureau of Mines, Department of Commerce. Production was the highest for any April, and shipments were exceeded only in one other, April, 1925. Portland cement stocks at the end of April decreased slightly but are second only to those at the end of March and are over 4 per cent greater than the stocks at the end of April, 1926.

The output of another new plant located in Western Pennsylvania is included for the first time in these statistics, which are prepared by the Division of Mineral Resources and Statistics of the Bureau of Mines and are compiled from reports for April, 1927, received direct from all manufacturing plants except two, for which estimates are necessary on account of lack of returns.



New Portable Test Meter

A new portable meter to be used as a standard in meter testing has been introduced by the General Electric Company. The new meter, designated as Type IB-7, is made for 110-220 volts, 25 or 60 cycles, and 1/5/20 amperes. The effects of variation in voltage, frequency and power-factor are minimized to negligible values, and there is almost entire freedom from temperature errors.

The case is of cast aluminum alloy, finished in black lacquer and is provided with a black leather carrying strap. The white enamel dial is easily read against the black bakelite top. A light, rigid aluminum alloy frame supports the entire meter element, and is firmly attached to the moulded bakelite top. The base of the frame is flat, so that when the metering unit is removed from the case it stands upright on the bench, facilitating inspection or adjustments.

Production, shipments, and stocks of finished Portland cement, by months, in 1926 and 1927

Month	Production 1926	Production 1927	Shipments 1926	Shipments 1927	Stocks at end of month 1926	Stocks at end of month 1927
January	7,887,000	8,258,000	5,674,000	5,968,000	20,582,000	22,914,000
February	7,731,000	7,377,000	5,820,000	6,731,000	22,385,000	23,560,000
March	10,390,000	11,452,000	9,539,000	11,083,000	23,236,000	*23,922,000
1st quarter	26,008,000	27,087,000	21,033,000	23,782,000	....	....
April	12,440,000	14,048,000	12,965,000	14,350,000	22,710,000	23,620,000
May	16,510,000	....	17,973,000	....	21,255,000	....
June	16,866,000	....	19,134,000	....	19,000,000	....
2nd quarter	45,816,000	....	50,072,000	....	....	....
July	17,134,000	....	18,812,000	....	17,301,000	....
August	16,995,000	....	18,583,000	....	15,718,000	....
September	16,571,000	....	18,087,000	....	14,188,000	....
3rd quarter	50,700,000	....	55,482,000	....	....	....
October	16,596,000	....	17,486,000	....	13,334,000	....
November	14,193,000	....	11,276,000	....	16,243,000	....
December	10,744,000	....	6,432,000	....	20,616,000	....
4th quarter	41,533,000	....	35,194,000	....	....	....
	164,057,000	....	161,781,000	....	....	....

*Revised.

EXPORTS AND IMPORTS*

Exports of hydraulic cement by countries, in March, 1927

Exported to	Barrels	Value
Canada	604	$ 3,331
Central America	12,208	33,358
Cuba	5,191	13,280
Other West Indies	4,214	10,145
Mexico	5,028	16,201
South America	35,066	129,818
Other countries	5,645	34,032
	67,956	$240,165

Imports of hydraulic cement by countries, and by districts, in March, 1927

Imported from	District into which imported	Barrels	Value
Belgium	Florida	59,642	$ 80,451
	Galveston	3,008	4,360
	Maine & New Hampshire	12,000	21,470
	Massachusetts	26,213	32,264
	New Orleans	9,853	12,178
	New York	149	300
	Oregon	3,000	4,317
	Porto Rico	11,528	22,869
	San Francisco	6,000	7,644
	Washington	100	169
	Total	131,498	186,022
Denmark and Faroe Islanas	Porto Rico	22,122	35,063
France	San Francisco	2,504	3,058
Germany	New Orleans	5,000	5,152
Japan and Chosen	Hawaii	5,000	9,798
Norway	Massachusetts	5,000	8,340
	South Carolina	6,000	7,570
	Total	11,000	15,910
United Kingdom	Massachusetts	1,496	2,413
	New York	1,025	1,694
	Philadelphia	1,500	2,409
	Total	4,021	6,516
	Grand total	181,145	$261,519

Exports and imports of hydraulic cement, by months, in 1926 and 1927

Month	Exports 1926 Barrels	Exports 1926 Value	Exports 1927 Barrels	Exports 1927 Value	Imports 1926 Barrels	Imports 1926 Value	Imports 1927 Barrles	Imports 1927 Value
January	72,939	$ 216,431	75,346	$254,072	360,580	$ 576,717	193,175	$269,661
February	73,975	220,706	71,404	233,985	314,118	527,948	130,421	200,680
March	69,080	205,647	67,956	240,165	493,241	812,968	181,145	261,519
April	96,296	284,772	.....	....	257,302	398,114	......	....
May	78,601	224,365	.....	....	223,130	337,031	......	....
June	80,684	248,814	.....	....	335,570	495,744	......	....
July	130,822	370,220	.....	....	250,862	395,981	......	....
August	64,946	216,489	.....	....	350,638	560,532	......	....
September	70,920	239,174	.....	....	194,129	308,224	......	....
October	69,389	225,874	.....	....	263,403	386,335	......	....
November	76,598	238,103	.....	....	55,233	82,949	......	....
December	89,976	305,238	.....	....	151,850	246,293	......	....
	974,226	$2,995,833	.....	....	3,250,056	$5,128,836	......	....

*Compiled from the records of the Bureau of Foreign and Domestic Commerce and subject to revision.

Link-Belt Elevators and Conveyors

The Link-Belt Company recently issued book number 575 under the title "Handling Things From Where They Are to Where You Want Them," which illustrates the possibilities of elevators and conveyors for various industries. It is a picture book of ideas that may suggest a better, more economical method or a more orderly way of moving material from one building, department, or machine, to another in a plant. Much study is often given to the selection of machines embodying the utmost in efficiency and speed and yet the moving of material from one stage to another in production is overlooked. This book is full of ideas dealing with this neglected subject.

The book shows many types of han-
variety of plant conditions, and it fur-
dling equipment, applied to a great
thermore illustrates that practically
every requirement presents a problem
for the study of an engineer, so as
to insure the selection of the most
suitable and efficient type of apparatus. The book is very complete in its illustrations, each of them being amplified with suitable text matter.

Link-Belt Power Hoe

Link-Belt Company has issued catalog number 666 describing the Link-Belt power hoe. This device is used in the handling and reclaiming of various bulk materials into and out of storage piles. The hoe is made with a sloping back plate or scoop which digs in until the top plate comes down on the material, which prevents its digging any more deeply; the sides act as guides and hold the load. This means that no matter how long or short the haul, the hoe cannot carry a load greater than that for which it is designed. This prevents overload on the ropes, sheaves and operating mechanism.

The hoe is operated to and fro by means of a double drum friction or gear engine, a wire rope, and properly designed sheaves. When used in conjunction with an elevator or loader to trucks or cars, large areas of storage can be reclaimed. It is made in standard sizes of 5/8, 1, 1½, 2, 3, 4 and 5 cubic yards, but other sizes, to meet any special conditions, can be built.

Newhall Moves N. Y. Office

The Newhall Chain Forge and Iron Company, manufacturers of Warwick crane, dredge, steam shovel and marine railway chains, have moved their New York office from 90 West Street to 8-12 Murray Street.

Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,625,553. Pulverizing-machine. William K. Liggett, Columbus, Ohio, assignor to Jeffrey Mfg. Co., same place.

1,625,554. Pulverizing-machine. William K. Liggett, Columbus, Ohio, assignor to Jeffrey Mfg. Co., same place.

1,625,762. Concrete-mixer. Orson C. Barrymore and Reginald A. Daddisman, San Francisco, Cal., assignors to Barrymore Concrete Mixer Corporation, same place.

1,625,853. Cement and lime burning. George E. Heyl. Westminster, London, England.

1,625,855. Power shovel. Johannes S. Huber, Milwaukee, Wis., assignor to Harnischfeger Corporation, same place.

1,625,859. Excavator-crane. Rolf Ljungkull, Milwaukee, Wis., assignor to Harnischfeger Corporation, same place.

1,625,887. Dry-pan crusher. John S. Fowler, San Mateo, Cal., assignor to Pacific Foundry Co., San Francisco, Cal.

1,626,019. Excavating apparatus. William A. Whitmire, Big Creek, Cal.

1,626,132. Mining-machine. Charles E. Davis, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,626,535. Machine for breaking ore and other minerals. Ralph Hush, Johannesburg, Transvaal, S. Africa.

1,626,577. Artificial stone or marble. Lon E. Welch, Memphis, Tenn.

1,626,653. Mine-car. Victor Willoughby, Ridgewood, N. J., assignor to American Car & Foundry Co., New York, N. Y.

1,626,654. Mine-car. Victor Willoughby, Ridgewood, N. J., assignor to American Car & Foundry Co., New York, N. Y.

1,626,830. Continuous automatic concrete-mixer. Milton F. Horst, Los Angeles, Cal.

1,626,879. Appliance for finishing concrete pavements. Frank L. Shidler and Robert D. Gregg, Kankakee, Ill.

1,627,170. Manufacture of hydraulic cement and the like. Oscar Gerlach, La Salle, Ill.

1,627,215. Limekiln and method of burning lime. Arthur E. Truesdell, Pittsfield, Mass., assignor to Doherty Research Co., New York, N. Y.

1,627,237. Process of manufacturing slag cement. Joseph G. Harding, Jackson, Ohio.

1,627,247. Loading-machine. Norton A. Newdick, Columbus, Ohio, assignor to Colader Co., same place.

1,627,296. Plastic composition product and method of producing articles of manufacture. Alger J. Slosser, Williamsport, Pa., assignor to Pompeian Flooring Co., same place.

1,627,487. Ball mill. Paul L. Crowe, Baltimore, Md.

1,627,488. Ball mill. Paul L. Crowe, Baltimore, Md.

1,627,553. Method of treating wet raw materials in the manufacture of cement. Johan S. Fasting, Valby, Denmark, assignor to F. L. Smidth & Co., New York, N. Y.

1,627,585. Treatment of cement raw materials in rotary kilns. Mikael Vogel-Jorgensen, Frederiksberg, Denmark, assignor to F. L. Smidth & Co., New York, N. Y.

1,627,599. Concrete cribbing. Elbert H. Dresser, Duluth, Minn.

1,627,869. Mechanism for operating and controlling excavator-dippers. George T. Ronk, Fairfield, Iowa.

1,627,872. Power-actuated bucket. Guy H. Strayer, Belle Valley, Pa.

1,628,000. Process for the manufacture of cement. Thomas Rigby, London England.

1,628,071. Power shovel. William W. Sloane, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,628,099. Coal-grinding mill. Milton W. Arrowood, Wilmette Ill.

1,628,097, Cement-kiln feeder. Robert W. Ryder, San Francisco, Cal., assignor to Santa Cruz Portland Cement Co., same place

1,628,294. Coal-pulverizer. Algot A. Wickland, Chicago, Ill.

1,629,309. Mining-machine carrier. Kenneth Davis, St. Benedict, Pa.

1,628,314. Skip-hoist system. William E. Hale, Fort Washington, Pa., assignor to R. H. Beaumont Co., Philadelphia, Pa.

1,628,316. Concrete form. John N. Heltzel, Warren, Ohio.

1,628,329. Mining and conveying machine. Richard Peale, St. Benedict, Pa.

1,628,378. Automatic discharge for concrete mixers. George E. Webb, Milwaukee, Wis.

1,628,455. Screen. Emil E. Deister, Fort Wayne, Ind.

1,628,619. Crusher. Carl G. Sprado, Milwaukee, Wis., assignor to Allis-Chalmers Mfg. Co., same place.

1,623,989. Ice concrete. Viktor Wikkula, Helsingfors, Finland.

1,624,032. Inner disk for disk crushers. Charles B. Andrews, High Bridge, N. J., assignor to Taylor-Wharton Iron & Steel Co., same place.

1,624,705. Concrete, mortar, and plaster mixer. George W. Adams, San Antonio, Tex.

1,624,886. Screen-bar for crushing machinery. George W. Borton, Philadelphia, Pa., assignor to Pennsylvania Crusher Co., New York, N. Y.

Climax Engine Freighted by Canoe and Pack Train

When the General Holding Company, Limited, of Edmonton, Alberta, Canada, took over a mica mining claim in Northern British Columbia, they found it necessary to pack in supplies, so inaccessible was the location in the heart of the Canadian Rockies. Among the equipment needed was a gasoline engine. A Climax Model "K" four-cylinder engine was purchased.

From the factory of the Climax Engineering Company the engine was shipped by railroad to the banks of the Peace River, a favorite location of Northwestern Mounted Police tales. Here the engine was dis-assembled, placed in birch-bark canoes and freighted up the river to the foothills of the Rockies, thence by pack horses to the final destination. At the claim the engine was re-assembled and worked perfectly. After two years arduous service, the only replacements needed were a gasket and a few bushings.

Speeder Cranes and Shovels

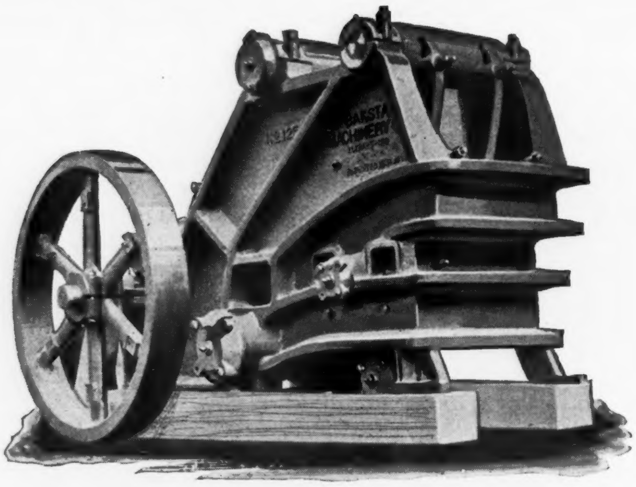
The Speeder Machinery Corporation has issued a folder with reprints of letters from owners of the Speeder shovel, pull shovel, skimmer, crane and dragline. These letters are from concerns using these machines for different classes of excavation work and demonstrate the success and satisfaction which they are giving in the field. One letter of particular interest is from the man who bought the first machine, in 1923, made by this company, and which is still in active service.

William B. Senseman Now District Manager

William B. Senseman has been appointed Pacific Coast district manager for Combustion Engineering Corporation, Raymond Bros. Impact Pulverizer Company, Ladd Water Tube Boiler Company, and Heine Boiler Company, all subsidiaries of International Combustion Engineering Corporation.

Mr. Senseman has been associated with Raymond Bros. Impact Pulverizer Company for the past 15 years and since 1917 has represented that organization on the Pacific Coast. The new consolidated offices are located in the Subway Terminal Building, 417 South Hill St., Los Angeles, California.

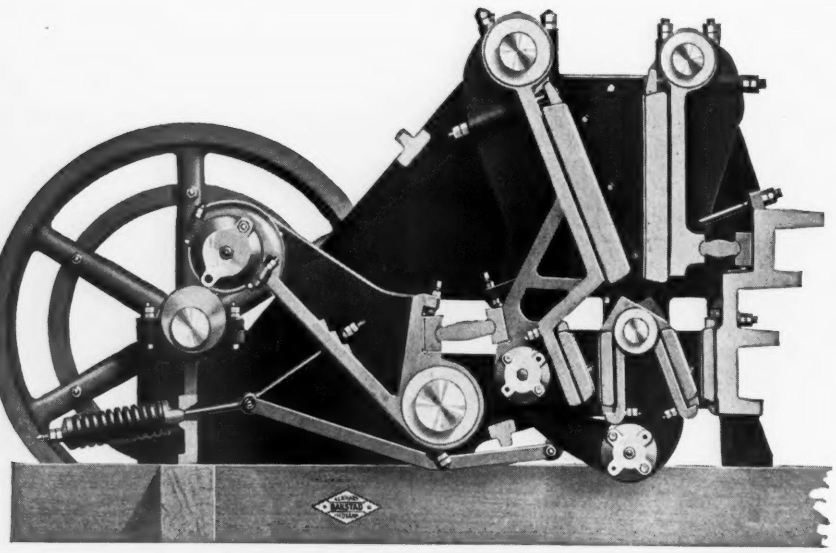
New Bakstad Crusher



General View of Bakstad Crusher

During recent years the demand for finer crushed material has increased. A crusher with three sets of crushing jaws in one unit has been developed by Mr. J. R. Bakstad and is placed on the market by The Bakstad Machinery Company, Inc., which he heads.

The general appearance of this new type of crusher and also a cross-section through the working parts are shown in the illustrations. It will be noted that the initial receiving opening and crushing path is similar to single unit crushers, but the machine is provided below this outlet with two additional crushing jaws which operate in unison with the moving jaw above. The primary moving jaw is suspended from a shaft, supported in the crusher frame, and designed to carry in its extension also a secondary crushing plate.



Sectional View of Bakstad Crusher

It will be noted that the initial stationary jaw, instead of being a rigid part of the machine, is also suspended from a shaft supported in the frame and backed with an adjusting toggle held in a seat against a rigid frame, thus allowing an independent adjustment for the initial breaker. Between the secondary crushing plate supported rigidly to the frame and the secondary plate carried by the main moving jaw, is located an intermediate crushing jaw, suspended from a shaft in the main frame. This intermediate crushing jaw carries two sets of renewable crushing plates, thus forming two separate secondary crushing plants. The intermediate jaw is also provided with a separator which distributes the product received from above, evenly to each side.

The intermediate jaw is connected by a link to the main moving jaw and receives its crushing motion through an adjusting and safety toggle from the lever, carried by a shaft in the frame. The lever is raised and lowered by the roller which it supports in one end, and as the cam shaft revolves, carries the balance wheels and belt pulleys.

As the three sets of jaws open and close in unison the stroke in the lower is just a little more than one half the movement in the upper jaw, and thus permits a finer setting and crushing. Adjustment of openings when required may be made by changing the main toggle. This adjustment affects both the primary and secondary discharge openings, always leaving the latter with equal settings; in addition an independent adjustment is provided for the primary jaw. It is obvious therefore that, comparing receiving openings, size for size, this machine will turn out twice the capacity of a set product or, for example, as much 1 inch product as would ordinarily be the capacity for two inch product with the single jaw alone.

The frame and all other principal parts are of cast steel; all bearings are dust-proof and provided with high pressure lubricators throughout and are reversible for wear. The crushing plates are of manganese steel, reversible for wear, and interchangeable from stationary to moving jaw in both the primary and secondary paths. Adjusting toggles, wedge bolts, etc., are readily accessible and the secondary jaw openings are reached through suitable portholes in the side frame.

The Bakstad Machinery Company will market this type of crusher in the various sizes demanded by the trade, both for stationary plants and in portable, mounted units, together with allied equipment for complete installations.

Austin Opens Branch

The Austin Company, engineers and builders, has opened a branch office in Cincinnati, which brings the total of offices throughout the country to thirteen. H. L. Cornelison, until recently manager of the Miami office, has been placed in charge of this office, which is located on the sixth floor of the Dixie Terminal Building. Territory covered by the office includes Southern Ohio, Southern Indiana and Kentucky. Over 200 industrial projects have been built by Austin in the Ohio Valley during the past five years. The Chicago headquarters of The Austin Company moved to larger quarters at 510 North Dearborn Street on May 1st.

Edward C. Dingman, who handles the sale of Climax engines in Quebec and the eastern provinces of Canada, has moved his office from the Keefer Building to 1120 Castle Building, 1410 Stanley Street.

Sales of Phosphate Rock in 1926

The total quantity of phosphate rock sold by producers in the United States in 1926 was 3,209,976 long tons, valued at $10,893,800, according to figures compiled by the United States Bureau of Mines, Department of Commerce, from individual reports furnished by producers. The figures indicate a decrease of 8 per cent in quantity and of 6 per cent in value as compared with 1925.

The quantity and value, by States, of the various kinds of phosphate rock mined in the United States and sold in 1926 were as follows:

	Long tons	Value
Florida:		
Hard rock	116,264	$ 465,308
Land pebble	2,591,943	8,218,200
	2,708,207	$8,683,508
Idaho:		
Western rock	33,113	133,020
Tennessee and Kentucky:		
Blue and brown rock	464,192	2,048,272
Wyoming:		
Western rock	4,464	29,000

Imports of phosphate rock in 1926 were 17,378 long tons, valued at $192,611, or more than 6 times as great in quantity and 5 times as great in value as those of 1925. Exports amounted to 749,163 long tons, valued at $4,440,074, a decrease of 14 per cent in quantity and 22 per cent in value.

Portland Cement Opens Montana Office

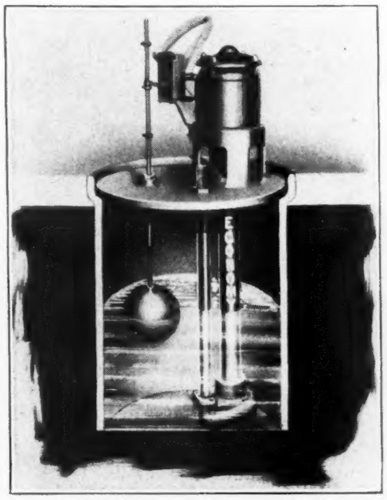
The Portland Cement Association announces the opening of an office in the Montana National Bank Building, Helena, Montana, in charge of A. L. Strong, district engineer, who will direct Association activities in the state of Montana. Mr. Strong has been on the district office staff of the Association at Yakima and Seattle, Washington, since 1920. Prior to this he had been engaged for ten years in city and county engineering.

Climax Appoints

The Climax Engineering Company has made the following additions to its sales force. H. P. McCullough will be located at Houston, Texas, with offices at 328 Chronicle Building, while E. H. Crippen will make his headquarters in Forth Worth, Texas, at 4023 W. 7th Street. Mr. McCullough and Mr. Crippen are both experienced in the oil field practice, as they received their training at the Climax engine factory and have a thorough understanding of the design and operation of Climax oil field units.

New Economy Sump Pump

In order to meet the demand for a heavy duty sump pump of smaller capacity than was previously available, Economy engineers have developed a one inch pump with a capacity of 10 to 20 gallons per minute against heads of from 10 to 18 feet. This new pump is the result of two years' experimentation on the part of the engineers and production departments. Particular attention is called to the fact that the pump is mounted on a snug fitting cover which does away with unsanitary open pits.



Economy Sump Pump

New Steel Barge Spud

The illustration shows a steel spud for gravel barges, built by Hetherington & Berner, manufacturers of the H & B line of gravel plant equipment. It is being used by the Western Indiana Gravel Company at their Metropolis, Illinois, plant, to replace timber spuds which have proved unequal to the heavy duty required of them. Timber spuds frequently break under the strain of holding a gravel barge steady while the operation of undercutting a bank is in progress. This steel spud eliminates this difficulty. It is 20 inches square, 60 feet long, and weighs between 6 and 7 tons. It has a semi-steel point. There is a removable sheave 12 feet from the point, through which the lifting cable runs.

This new product is a big saver of time and money for operators using gravel barges. It holds the barge steady even under heaviest strains, thus giving greater leverage and efficiency and eliminating danger of failure in service that is present when wooden spuds are used. The lifting-cable raises the spud quickly and easily, and after the barge is moved to its new location, the spud is released, sinking by its own weight into a rigid footing in the floor of the pit.

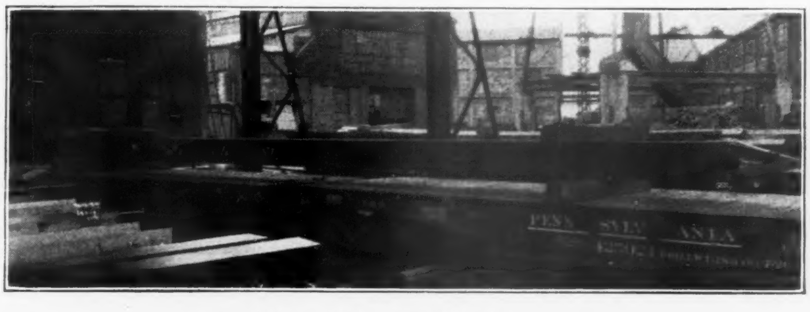
Heaters for Change-Houses Operated by Electricity

A convenient and safe source of heat for change-houses in the oil and mining fields and for use in building and construction work is offered by the new electric change-house heater, type HA, manufactured by the Westinghouse Electric and Manufacturing Company.

The heater consists of an angle iron and sheet metal frame, two oven heaters being suspended under the shelf and protected by an expanded metal screen. A rack at the top is useful for holding clothing while drying, the shelf being used to warm lunches or for other purposes. An oil immersed switch is used for turning the power off and on. For ordinary applications where oil switches are not required, a WK-62 safety switch is used. The apparatus is strongly constructed and weighs slightly over 100 lbs. The overall dimensions are 18 by 50 by 50 inches high. The power required is 10 kw. and a source of either 220 or 440 volts, single phase, may be used.

Massillon Power Shovel Purchases Russell

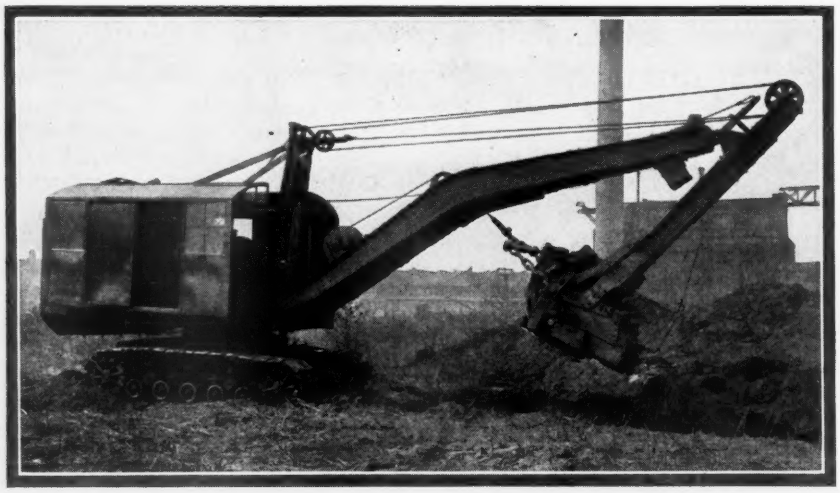
The Massillon Power Shovel Company announces the purchase of the power shovel division of The Russell & Company and the plant and business of the Massillon Foundry & Machine Company. The company has in production the well known Massillon full revolving shovels, cranes, clam shells and drag lines, equipped with steam, internal combustion engines, or electric motive power.



New Steel Barge Spud

New P & H Trench Machine

The trench hoe equipped with goose-neck boom has been designed by Harnischfeger Corporation. This improved hoe is one of eight attachments which can be used on machines they are manufacturing. The goose-neck boom permits digging to a greater depth than is possilbe with the old straight type of boom. The model 700 trench hoe digs to a depth of 24 feet and has a working reach of 36 feet 6 inches.



New P. & H. Machine

Harnischfeger Corporation is equipping their 1 yard and 1¼ yard machines with this improved type of boom. The 1 yard machine, model 600, with dipper teeth adjustments, cuts trench from 38 to 42 inches in width. The 1¼ yard, model 700, cuts trench from 46 to 52 inches in width. Any width of trench beyond 52 inches can be cut by shifting the course of the dipper. The dipper can be dumped from the front or bottom, and the dipper door is provided with a special locking device.

Du Pont Opens New Plant

The new dynamite plant of E. I. du Pont de Nemours & Company at Mineral Springs, a short distance from Birmingham, Alabama, which has just been completed, recently began the actual manufacture of dynamite. This is the largest dynamite plant in the South and has an annual capacity of 15,000,000 pounds. It is contained within an area of 1,280 acres and comprises some fifty separate buildings of the most modern type for this kind of manufacture and equipped with the latest machinery.

The water supply will come from a concrete dam which has been constructed to impound 65,000,000 gallons of water. Ten thousand feet of railroad and industrial trackage has been built within the plant area to handle materials from building to building, and the finished products to shipping points and magazines. A complete line of dynamite and gelatin dynamites will be manufactured at the plant. These will include explosives for every kind of operation in the South, from submarine blasting to coal and metal mining, quarrying, lumbering, and agricultureal uses, including ditch blasting. Distributing facilities are also provided at the plant for blasting supplies and for distributing black powder from the company's plant at Connable, Alabama.

The plant is manned by a staff of explosives experts. The officials are E. B. Yancey, manager; H. O. Thayer, assistant manager; H. F. Brown, powder superintendent; T. F. Corcoran, acid superintendent; J. A. Mooney, acid assistant; C. F. Reed, power and maintenance supervisor; R. R. Hull, chemist, and J. C. Albrechtson, chief clerk.

Economy Pump in New Factory

The principal manufacturing operations and the general office of the Economy Pumping Machinery Company will be moved to its new plant, 3431 W. 48th Place, Chicago, Illinois, on May 1st. The foundry and some specialized lines will be continued in the Joliet plant. The new plant is a modern two story structure, designed by A. Epstein, Chicago architect for the Central Manufacturing District. It is of brick and steel construction, 100 feet wide by 200 feet long. The first floor is at carbody and truck level, with a loading platform the full length of the building. Switch track will accommodate five cars so that both incoming and outgoing shipments can be efficiently handled.

The company's general office, engineering department, pattern shop and other light work will be located on the second floor while the heavy machine work will be done on the first floor. Three divisions have been made in laying out the manufacturing space, each with independent crane service. Of particular interest to pump users is the unusual testing and experimental laboratory. The test tank is of sufficient size to handle pumps of capacities up to 15,000,000 gallons every twenty-four hours. A large number of independent electrical test boards are provided for testing pumps of all sizes up to 200 h.p. simultaneously. This laboratory is a very necessary part of the Economy plant, as all pumps manufactured by this company are tested before shipment.

New Floodlight Projector

A new 24-inch floodlight projector, known as the Type SCA-24, has been developed by the Westinghouse Electric and Manufacturing Company for use where long throw and high beam candle-power are essential. The large diameter of the reflector in the new floodlight makes possible a wide angle of light with high overall efficiency. Its long focal distance gives good beam concentration for long range work.

The 24-inch parabolic chromium plated brass reflector is mounted in a cast aluminum alloy frame with a spun sheet aluminum back. The lens, of heat resisting glass, is held in a door which opens from the front, swinging sideways. Thus, it is possible to renew lamps and clean the reflector without interference from the door. The floodlight is mounted so that it can be tilted upward where its position is such that approach from the front is not practical. A stop is provided so that it is unnecessary to aim the projector each time it is moved from position. Focal adjustment is provided by three screws, which operate independently, two for "in" and "out" and lateral motion of the lamp, and one for adjustment of focal distance.

J. Redfern Joins the Climax

Mr. Jack Redfern has joined the Climax Engineering Company, as sales representative. At one time, Mr. Redfern was sales manager of the Power Manufacturing Company. He has had an extensive experience in the sale of gasoline and oil engines and enjoys a wide acquaintanceship among engine users. At the present time he is on the Pacific Coast in the interests of the Climax organization.

Hardinge Conical Mill

The Hardinge Company has issued a bulletin, number 17-A, describing dry grinding with the Hardinge Conical mill and reverse current air classifier. The purpose of this bulletin is to outline the principles and describe the methods employed for grinding various material dry. Open circuit grinding is that method where the material is fed in at one end of the mill and is discharged at the other in a finished state. This principle is often employed for relatively coarse grinding, or where a close sizing is not required.

Where a uniform product is required up to a fineness of 35 to possibly 48 mesh, a mill operating in conjunction with a vibrating screen gives better results than one operating in open circuit without screens. Where screens are used, the product from the mill passes over them, the fine material that goes through is considered finished, or ready for the next step in the process, and the coarse or oversize remaining on the screens is returned to the mill for regrinding. In this way, the capacity of the mill is considerably increased, as it does not need to be held back to grind the few particles of coarse material which usually get through with the finished product. When screens are used, these coarse particles are allowed to come through and are then returned to the feed end of the mill for regrinding.

Where a product finer than 35 to 48 mesh is required, air classification is used, as screens generally are not economical beyond this point. The first method employed for grinding in closed circuit with air classifiers was through the use of an independent classifier, usually termed air separator. The product of the mill was conveyed to the classifier, usually by bucket elevator. The classifier separated the material, sending the oversize back to the feed end of the mill and the finished product to the bin or the next step in the process.

When what is known as the "air swept" principle was developed, it was recognized that if material could be removed from the mill as soon as ground, greater capacity and, therefore, higher overall efficiency could be secured. The "air swept" system took somewhat more power, and the materials in going through the fan caused excessive fan wear.

As a result of research and experiment, the principle of reversed air current was discovered. In this system two distinct units are used, the Hardinge reverse current air classifier and the superfine classifier. In the process of grinding, the material travels toward the discharge end of the mill. Air is blown into the mill through the central pipe in the discharge end, and as the mill rotates, stirring up the material, the fine particles are sucked out through the space between the hollow trunnion and central pipe in the discharge end and into the Rotary Classifier. If the Rotary only is used, any oversize which may have been drawn through with the fines settles out in this unit and is blown back into the mill for re-grinding, while the fine material is carried up the pipe to the product collector. If the Rotary and Superfine are both used, the first separation takes place in the Rotary and a second separation occurs in the Superfine, the finished product then being carried directly to the product collector.

New Magnetic Switch

To meet the demand for a smaller and cheaper magnetic switch with temperature overload relays, the General Electric Company has designed a device bearing the designation CR-7006-D-20. The enclosing case is of the drawn-shell type, both box and cover being of the same dimensions. The cover hooks over two pins at the top and is fastened by means of a screw at the bottom. During installation the base is removed from the case, thus making it easier to fasten the case of its mounting, to install the conduit and pull in the leads.

Very large barriers are used, permitting the switch to interrupt extremely high currents. The electrical interlock is so designed that, by removing a wire from the back of the base, it is possible to use the switch on insulated circuits. Overload protection is provided by means of a Trumbull relay held in position on the panel by fuse clips. These relays can easily be changed to suit the size of motors involved. The relays are self-resetting and, therefore, the switch can be used with three-wire circuit control only.

International G. E. Elects Officers

Dwight W. Morrow, of J. P. Morgan and Company, and Victor M. Cutter, president of the United Fruit Company, were elected directors of the International General Electric Company at a meeting of the board recently. Gerard Swope, president of the General Electric Company, was elected chairman of the board, succeeding the late Anson W. Burchard; Clark H. Minor was re-elected president; Walter J. Edmonds, comptroller, was elected a new vice-president in charge of financial relations; and E. F. Colyer was named comptroller.

Link-Belt Company Builds

Announcement is made by Link-Belt Limited, that Jackson-Lewis Company Limited, Toronto, have been appointed general contractors on the first unit of the building program of the Company. The Company's property is located at the corner of Eastern Avenue and Leslie Street, Toronto. The unit now in course of construction will consist of a two-story building, 80x160 feet. Of buff pressed clay brick, the walls will be trimmed with Queenston limestone. The supports of structural steel, are being supplied by McGregor & McIntyre, Limited, of Toronto.

The first floor, on which are located the heavier machines, is to be constructed of concrete, overlaid with creosoted wood blocks, and will be at car door height. The second floor will be constructed of British Columbia fir, laminated. The office will be located on this floor, taking up a space of 40x80 feet. A freight elevator and conveyor will handle the material between the first and second floor. It should be interesting to note in this connection that the factories of Link-Belt Company, with subsidiaries, now number eleven; its warehouses, thirteen; and the total number of its branch offices, thirty-seven.

Production of Asbestos in 1926

The total quantity of asbestos sold or used by producers in the United States in 1926 was 1,358 short tons, valued at $134,731, according to figures compiled by the United States Bureau of Mines, Department of Commerce, from individual reports furnished by producers. These figures represent chrysotile asbestos mined in Arizona, and amphibole asbestos mined in Georgia and Maryland. The sales of chrysotile asbestos were much larger both in quantity and value than those of 1925, and the sales of amphibole asbestos showed a decrease in quantity but an increase in value.

Imports of unmanufactured asbestos for consumption amounted in 1926 to 257,621 short tons, valued at $8,142,505, and the exports were 1,104 short tons, valued at $85,922. Corresponding figures for 1925 were: imports, 230,520 tons, valued at $7,134,302; exports, 1,109 tons, valued at $70,846.

Harnischfeger Corporation of Milwaukee, Wisconsin, have moved their Dallas, Texas, office from 401 Fidelity Union Building to the Construction Industries Building.

Phoenix Portland Installs Norblo System

The Phoenix Portland Cement Company recently had installed a dust-collecting system at its Birmingham, Alabama, plant. The Northern Blower Company, to whom the entire equipment and installation contract was awarded, undertook to make the plant completely dustless, and has met with excellent success.

In the stone crushing department the material is unloaded from the quarry cars and treated successively in a gyro crusher and a hammer-mill. To deal successfully with the large volumes of dust produced by these operations, close-fitting hoods and pipes conduct the dust from all sources to two cloth screen type Norblo dust-arresters. The air is drawn through the closely woven fabric of the screens by means of exhaust fans. Since the fans are placed on the exhaust side of the arresters, no dust is permitted to come into contact with the blades, thus minimizing the wear. Another feature is the method of driving the fans by means of a motor having a shaft extension on each end. This plan equalizes the weight and end-thrust of the fans and prevents unequal wear on the motor bearings. Both fans are of the standard Norblo high-efficiency low-speed type. The rapping devices by means of which the cloth screens may be vibrated periodically in order to shake off the accumulations of dust into the hoppers below, are on the sides of the arresters at the level of the platform. These rappers as a rule only need to be operated for about five minutes every few hours.

The finish mill presents a surprising contrast to what is the general conception of such a department. The air is clean and fresh. All machinery has been given a thorough coat of light green paint, and extra coats of varnish over this. Heavy rubber floor covering suggests the neatness of a power plant rather than what is generally considered one of the dustiest departments of any cement mill. This suggestion is still further increased by the fact that owing to the complete absence of any trace of dust, it was found perfectly practical to install the driving motors, and even the delicate electrical control gear, in the same room as the tube mills themselves.

A Norblo continuous suction air-filter is used in the finish grinding mill. This continuous suction air-filter consists of 12 separate steel case units, each containing twelve filter bags through which the air is drawn by the suction produced by two exhaust fans on either side of the motor. In order to permit continuous operation, even should it be necessary to shut down one or more of the units for inspection or adjustments, the flow of the air is controlled by individual counterweighted valves on each unit and by a rotary motor-driven master-valve which switches the air current through each unit in rapid succession. As each unit completes its brief period of filtering action, the rotary valve switches the air to the next, the counterweighted valve on the first unit closes, and the air current being thus reversed in it, the filter bags are freed from their collected dust ready for the next cycle of operation.

The bag-house is equipped with a 70 foot Norblo cloth screen dust-arrester of the same general construction as that used in the stone-crushing department. This dust-arrester extends over the entire roof of the building, and pipes lead to it from all dust-sources. The system is also used for ventilating the tops of the silos and the vent which comes from the Fuller-Kenyon compressed air pumps which discharge the cement into the silo bins.

Mead-Morrison Hoists

Mead-Morrison Manufacturing Company recently issued bulletin number 130 describing the Mead-Morrison dragline and slackline hoists. On the dragline hoist the different speeds of upper and lower drums are obtained by different gear ratios. The large diameter of the lower drum gives the required pull without injuring the cable line. The chance of rope jamming with its resultant hold-up of production is further eliminated by a drag brake which prevents slack in the tension-cable.

The hoist is driven by a high torque motor which runs continuously. Two levers control every operation. Self-acting brakes handle the load without attention on the part of the hoist man. Cone frictions, which are asbestos lined, operate efficiently regardless of the heating and expansion of the drum under heavy continuous duty. These frictions are easily replaced without removing the drum shaft from the bearings.

The drum gears are built so that the friction surface of the asbestos is fastened to the web of the gear. The design is such that oil from the bearings is carried back to the surface of the drum, where it acts as a lubricant for the wire rope. Hence the asbestos frictions are always dry and afford the maximum coefficient of friction. The main pinions are between the drums and both drums revolve in the same direction when hauling cable.

The slackline hoist is also simple of operation, is provided with automatic brakes and a two speed device. This machine, similar to the dragline hoist, has ball bearings between thrust bearings, asbestos friction and machine cut washings with forged or cast steel pinions also having cut teeth. The motor is a continuous running, specially wound type that builds up torque as the load increases. This hoist has only five levers for its complete operation. Both types of hoist are built for either electric, steam or gasoline engine drive.

Bay City Tractor Shovel Now with Trencher Attachment

The Bay City tractor shovel is now available with boom and bucket for trench excavation. This shovel has already been brought to the attention of the public with shovel type dipper, but no announcement has yet been made of the fact that this machine is now available with a trencher attachment. This trench or ditcher attachment is so designed that it can be installed on any Bay City tractor shovel. The attachment consists of an extension mast, boom and trencher bucket, patterned almost exactly after the ditcher attachment, furnished on the Model 16-B-¾ Yd. convertible excavator. This attachment will dig to a depth of not more than eleven or twelve feet and is suitable for trench Model 16-B-¾ yd. convertible excavation, the excavation of house sewer connections or the excavation of basements on jobs where it is desired to keep the machine on top of the bank.

The machine has three propelling speeds, the fastest of which is 3½ miles an hour. It is one-man operated and equipped with full-crawler mounting. The bearing pressure per square inch of ground surface is only 5½ pounds. Power is supplied by the McCormick-Deering tractor. The machine is designed with fast operating speeds and special analysis steel, Timken roller bearings, etc. are used throughout. The standard bucket width is twenty-four inches and slightly narrower or wider buckets can be furnished. The bucket dumps by inverting.

New Pennsylvania Bulletin

The Pennsylvania Pump & Compressor Company, Easton, Pennsylvania announces the publication of a new bulletin, Number 132, describing their single stage air compressor and vacuum pumps. Included in this bulletin is a description of their class 3-AE direct synchronous motor connected air compressors.

When Your Oils Thin Out

By G. S. Hamilton

We all know that after engine oil has been used for a time it loses its body, and we sometimes refer to the change as breaking down. Oil does not break down, or undergo any permanent thinning out when it is heated.

A mixture of oil and gasoline is naturally thinner than new oil and this is exactly what we have in the crankcase when the oil is said to have "thinned out." Unvaporized gasoline in the cylinders leaks past the pistons and mixes with the oil in the crankcase. Whenever there is an excess of liquid fuel in the cylinders this is bound to happen.

We know that new oil will separate the moving parts better than thinned oil, although the latter might give us fair lubrication under ideal conditions. To prevent engine wear we want to separate the moving parts far enough so that the particles of road dust and other abrasives that are carried in the oil film will not touch the metal surfaces and cut them. This road dust and abrasive material is drawn in with the air through the carburetor to an extent that varies with the operating conditions.

For the longest engine wear the oil should not be allowed to thin out too much and abrasives should not be allowed to accumulate. If oil is not changed at proper intervals, at least every 50 hours of service, the abrasives, under ordinary conditions, will accumulate to an extent that will cause damage. Oil which is not used too long and which is kept reasonably warm is usually clean oil of proper body. With this protection the engine will give many times the service that would be possible otherwise.

New Paint Spray Unit

The Alexander Milburn Company has recently placed on the market a paint spray unit known as the Milburn Type E-1 siphon-feed outfit. This outfit with the Type E gun furnished, is adaptable to a wide range of painting. It is used for painting and lacquering and will operate efficiently whether using heavy anti-corrosive paints or very thin lacquers. The gun can be adjusted for such fine work as touching-up, shading and high-lighting up to larger work. An ordinary air compressor affords a sufficient volume of air to operate the gun.

The atomization of the spray is so fine and even that "orange-peel" is eliminated, minimizing sanding and rubbing. The atomized spray is surrounded by an air pocket which lessens the loss of material, utilizing the entire spray in thoroughly covering the surface. This means greater coverage with minimum paint consumption. The air purifier is of scientific construction delivering only pure, dry air to the gun. This is essential for good finishing results. The air, upon entering the purifier, passes through a series of double baffles which extract moisture and other impurities from the air. This unit is complete ready to begin work. It consists of the Milburn Type E gun with quart container, air conditioner, air regulator and 25 feet air hose with necessary connections and is built to withstand constant service.

General Electric Favors Welded Construction

The use of welding as a means of construction of factory and other plant buildings is to be adopted by the General Electric Company in future building programs, it has been announced by that company. The reason given for this policy is the fact that a study of structural design has shown that company conclusively that the welded structure can be made with less material than the riveted structure for the same loads.

This company feels that its experience with welding indicates conclusively that, as soon as shop methods are developed, it will be possible to fabricate buildings by the use of welded joints cheaper than they can be fabricated by the use of riveted joints. This, it is expected, will lead to the use of welding as a means of economy.

Those in charge of building plans make it plain that there is no conflict between welding and riveting at the present time, each having its own sphere and continuing to be used. The feeling is, however, that, as welding becomes cheaper than riveting, it will supplant it.

New Float Switch

The General Electric Company announces a new float switch bearing the designation CR-2931-P for use in control circuits only. This switch, in general, will be used to control the line contactor of alternating or direct current automatic starters. It has a capacity for handling one 600-ampere, two 300-ampere or four 150-ampere alternating-current, or direct-current contactors at from 110 to 550 volts.

The switch may be attached directly to a support extending across the tank or by means of a side bracket supplied with it. This bracket is reversible, and provides for various methods of fastening. The case, which is splash-proof, has provision for a half-inch conduit at the top.

Westinghouse Opens New Building

The Westinghouse Electric and Manufacturing Company opened Tuesday, April 26, the new Westinghouse Building in Wilkes-Barre, Pennsylvania, the first home and service shop maintained by this organization since it entered the field in Northwestern Pennsylvania some twenty years ago.

The Westinghouse executives present at the formal opening to bid their guests welcome included Mr. W. F. James, district manager of Philadelphia, Mr. H. V. Rugg, district service manager of Philadelphia, as well as a number of division managers and engineers from the Philadelphia district office. Wilkes-Barre officials were headed by Mr. J. B. Parks, branch manager, and H. L. Huntley, who has just been appointed service manager in charge at Wilkes-Barre.

New Whitcomb Appointments

The Geo. D. Whitcomb Company has signed a contract with the American Machinery & Supply Company, Omaha, Nebraska. This firm, handling industrial plant equipment, contractors' supplies, etc., will cover the entire state of Nebraska and western Iowa.

This company also announces the appointment of the Clyde Company, New Orleans, Louisiana, as representatives for Louisiana and the southern halves of the states of Mississippi and Alabama. The Clyde Company, long established in this field, are the direct representatives of the Clyde Iron Works of Duluth, Minnesota, well known manufacturers of heavy industrial equipment.

New Blaw-Knox Bucket

The Blaw-Knox Company has recently developed a new drag line 1¼ cubic yard bucket which is claimed to be built strong and sturdy to withstand hard, rough work. The bucket fills quickly and dumps clean and fast, thereby increasing the crane output and getting greater yardage without increasing the gross loading of the crane.

The bucket of this type which was exhibited at the 1927 Good Roads Show in Chicago was purchased by a Chicago concern and put to work on a 30-B Bucyrus Crane. Its duty was excavating prairie soil, good average digging, and the machine handles this 1¼ yard bucket on a 45 foot boom. It is a simple clean cut design, with alloy steel lips, trunnion link bushings, and dragline connection bushings which tend to provide long life for these wearing parts.

Rates for display advertisements in the Broadcast Section are given below. If you want to buy or sell used equipment, if you want a job or need a man, advertise your wants in Pit and Quarry. Advertisement copy for publication in the next issue should reach our office within one week after the date of this issue.

RATES PER INSERTION	1 Inch	2 Inches	3 Inches	4 Inches	5 Inches	6 Inches	8 Inches	9 Inches	10 Inches	12 Inches	15 Inches	20 Inches	30 Inches
1 Insertion	$3.75	$7.25	$10.75	$14.25	$17.75	$21.25	$28.25	$31.75	$35.25	$42.25	$56.25	$70.25	$105.00
2 Insertions	3.75	7.25	10.70	14.20	17.65	21.15	28.15	31.65	35.15	42.15	56.15	70.00	104.00
3 Insertions	3.75	7.20	10.65	14.15	17.55	21.05	28.05	31.55	35.10	42.05	56.05	69.75	103.00
4 Insertions	3.70	7.15	10.60	14.10	17.45	20.95	27.95	31.45	35.00	41.95	55.90	68.75	101.00
8 Insertions	3.65	7.05	10.50	14.00	17.25	20.75	27.75	31.25	34.80	41.75	55.70	67.50	98.00
13 Insertions	3.60	6.95	10.40	13.90	17.05	20.55	27.55	31.05	34.60	41.55	55.55	66.25	94.00
26 Insertions	3.50	6.75	10.20	13.70	16.65	20.05	27.05	30.65	34.20	41.05	55.05	64.00	88.00

INFORMATION—*"Broadcast"* space is sold by the advertising "inch." Each page contains 30 inches. The width of the page is divided into 3 columns, each 2¼ inches wide. Each column contains 10 inches measured the length of the column. Any space may be used measured by the *even* inch in height (not fractions), by 1, 2 or 3 columns in width. The size of a space is its height in inches multiplied by the number of columns in width. Example: a space 3 inches high by 2 columns wide is 6 inches. Copy changes made without additional charge.

Complete Service Publishing Company

538 South Clark Street **CHICAGO**

FOR SALE OR RENT

All equipment overhauled in our Shop is furnished in guaranteed condition, subject to thirty days' trial in service.

STEAM SHOVELS—RAILROAD TYPE

1—Model 80 Marion, Shop No. 1312, 4 yd.
3—70-ton Bucyrus. Shop Nos. 920, 939, and 1233. 2½-yd. dippers.
1—Model 60 Marion. Shop No. 2059, 2½-yd. dipper.
3—60-C Bucyrus. Shop No. 1286, 1358 and 1640, 2½-yd. dippers.
1—45-C Bucyrus. Shop No. 1202. 1¾-yd. dipper.

SHOVELS—FULL REVOLVING

1—80-B Bucyrus, Shop. No. 4002, New 1924 caterpillars, 41-ft. 6-in. Boom, 34-ft. Dipper Arm and 2½-yd. dipper.
1—37 Marion. Shop No. 4773, 32 ft. boom, 22 ft. dipper arm, 1¼-yd. dipper. Caterpillars.
1—Osgood 29, Shop No. 1170, standard boom, 1-yd. dipper, steel caterpillars.
1—Model 105 Northwest, Shop No. 1217, New, steel caterpillars, 1-yd. capacity.
1—30-B Bucyrus, Shop No. 3922. Standard boom, 1-yd. dipper, steel caterpillars.
1—Koehring Gasoline Shovel, Shop No. 384, new, 1926. Standard boom equipment, ¾-yd. dipper, steel caterpillar.
3—Type "B" Eries Shop Nos. 1989, 2703 and 2265, high lift. All ¾ yard. Steel caterpillars.
1—Model 21 Marion. Shop No. 4294, steel caterpillars, ¾ yd.
1—Type O Thew, Shop No. 1777, high-lift, traction wheels, 2/3-yd. dipper.
1—18-B Bucyrus. Shop No. 1870. ⅞-yd. dipper. Traction.

SIDE DUMP CARS

9—30-yd. Western, all-steel, air dump.
20—20-yd. Western, all-steel, air dump.
12—18-yd. Western, all-steel.
61—16-yd. Western, wood beds, air dump.
64—12-yd. Western Side Dump, wood beds.
2—6-yd. K. & J. Steel Sills Truss-rod doors.
2—5-yd. K. & J. 36-in. ga. Steel draw-sills, wood beds.
12—4-yd. Western, 36-in. gauge, heavy duty.
5—2-yd. Western, 36-in. ga., wood draw-sills, wood beds.
4—1½-yd. Western, 24-in. ga., wood beds.

STEAM SHOVEL PARTS

All repair parts on hand for Model 60 Marion and standard 70-ton Bucyrus Steam Shovels.

1—Std. boom, dipper arm and ¾-yd. dipper for Type "B" Erie.

2—32-ft. and 40-ft steel boom, drum, etc. for Type "B" Erie Crane.

LOCOMOTIVES

2—10x16 Davenports. Shop No's. 1918 and 1919, new 1922. Weight 19½ tons. A.S.M.E. boilers. 36-in. gauge.
1—10x16 Vulcan 4-wheeled saddle tank, Shop No. 3266, 36-in. gauge, 19 tons.
1—10x16 Porter 4-wheeled Saddle Tank. Shop No. 4251, wt. 19 tons, 165 lb. steam pressure.
2—10x16 Baldwin, 36-in. ga., 4-wheeled Saddle Tanks. Wt. 19½ tons. Shop Nos. 12161 and 28353.
1—9x14 Porter 36-in. gauge saddle tank. Shop No. 6960.
2—30-ton Climax Locomotives, 36-in. ga. New 1925.
4—7x12 Davenport and Vulcan, 24-in. gauge, 9-ton dinkies.
1—7x12 Davenport, 36-in. saddle tank. Shop No. 1567.
1—12-ton Standard Gauge Whitcomb Gas. four-speed.
1—6-ton, 24-in. gauge Whitcomb Gas, gear drive.

DRAGLINE EXCAVATORS

1—Class 24 Bucyrus. Shop No. 859, equalizing trucks, 100-ft. boom, 3½-yd. Page bucket. A.S.M.E. boiler.
1—Class 20 Bucyrus Draglines. Shop No. 740, 85-ft. boom, 2½-yd. dragline bucket. Skids and rollers.
2—Class 14 Bucyrus, steam operated. Shop Nos. 2140 and 3706, steel caterpillars, 60-ft. boom, 2-yd. bucket. A.S.M.E. boiler.
1—Class 14 Bucyrus, Shop No. 745, skids and rolls, 60-ft. boom, 2-yd. bucket.
2—No. 2 Monighan steam operated. Shop Nos. 789 and 1587, skids and rollers, 60-ft. boom, 2-yd. Page bucket.
1—Model 104 Northwest, gasoline, 769, new 1925. 45-ft. boom, steel caterpillars.
4—Koehring Crawler Draglines, Shop Nos. 337, 382, 384, and 453, gasoline, 40-ft. boom, ¾-yd. Page Buckets. New 1925 and 1926.
1—30-B Bucyrus Shop No. 3641, steel caterpillars, 40-ft. boom, 1-yd. Page bucket.
1—Model 210 P&H Gasoline Dragline. Shop No. 1077 Armored caterpillars. 40-ft. boom, 1-yd. Page bucket.

CRANES

1—P & H Crawler Crane, Shop No. 2067. New 1926, 40-ft. boom bucket-operating, ¾-yd. clamshell, also fairlead.
1—30-B Bucyrus, Shop No. 3922, steel caterpillars, bucket operating drums.
2—K-1 Koehring Crawler Cranes, 40-ft. booms, bucket-operating, Wisconsin motors.
1—21-ton Industrial, 8-wheeled, Crane, Shop No. 2706, 50-ft. boom, bucket-operating.
1—Type "B" Erie, Shop No. 2703, 36-ft. boom, bucket-operating, caterpillars.
1—15-ton Brownhoist 8-wheeled Crane. Shop No. 4520.
1—20-ton McMyler, No. 388, 50-ft. boom. bucket-operating.
1—18-ton Brownhoist, Shop No. 6583, 50-ft. boom, bucket-operating, A.S.M.E. Boiler.

BUCKETS

1—¾-yd. Williams "Favorite" clamshell.
1—¾-yd. Lakewood clam shell.
1—1¼-yd. O. & S. Clam Shell.
1—1-yd. Blaw-Knox Dreadnaught with teeth.
1—1-yd. Class "M" Page Dragline Bucket.
1—1½-yd. Brownhoist Clam Shell.
1—1½-yd. Mead-Morrison Clam Shell.
1—1-yd. Browning, Digging Type with teeth.
2—1½-yd. Page Dragline Buckets.

MISCELLANEOUS

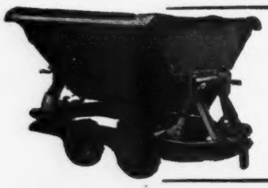
10—50 ft. Camp Cars.
1—Standard gauge Nordberg Track Shifter, gasoline operated.
1—10-ton Austin 3-wheeled Gaso. Roller.
1—No. 7-S Knickerbocker Concrete Mixer. with power loader and water tank on trucks. New.
1—American Railroad Ditcher No. 459.
1—8-ft. Austin Giant Road Grader.
1—6½x10 D.C., D.D. American Hoist. with butt strapped boiler.
35—Milburn Carbide Lights.
1—No. 55 Buhl Portable Air Compressor.
1—Model 10 Keystone Mixer, low charger, 6 Hp. Novo Gas Engine.
1—No. 6 Keystone Mixer, 3 Hp. Novo Engine.
1—7x8 Gould triplex Pump, belt driven.
1—4x6 Fairbanks-Morse Duplex Pump with 7½ hp. motor.
1—Buffalo-Springfield Roller, 10-ton, 3-wheel, No. 10707. New 1923.

CLAPP, RILEY & HALL EQUIPMENT CO., 14 No. Clinton St., Chicago, Ill.
BECK, RILEY & HALL EQUIPMENT CO., 458 Union Trust Bldg., Pittsburgh, Pa.

FOR SALE

1—No. 5 Allis-Chalmers and 1 No. 4 crusher with reduction head. 40 ft. elevator and 40 inch diameter revolving screen. 50 HP. A-C motor. 3-phase, 60 cycle, 2200 volt. Outfit 6 yrs. old, but only crushed 10,000 yds. soft limestone. Crushers in A-1 condition. Entire outfit $2,800 or will split up.
1—Practically new No. 5 Telsmith, late type, $1,600.

M. WENZEL
4029 South Benton Kansas City, Mo.



100—NEW V-DUMP CARS

1½ & 1 cu. yd. x 24 in. and 36 in. Gage
Immediate Shipment
Quick to Move—Attractive Prices

Also New and Relaying Rails—Portable Track

New York City, Park Row Bldg. — **M. K. FRANK** — **Pittsburgh, Pa., Union Trust Bldg.**

Everyone Today Is Interested in Gas-Electric Motive Power

The New "Davenport" Gas-Electric Locomotive

General Electric Equipped

Is the Most Powerful Locomotive of Its Size Ever Built for—

Industrial Switching, Brick Yards, Plantations, Contractors, Steel Mills, Coal Mines, Quarries, Cement Plants, Logging and Branch Line Railroads.

The "Davenport" GAS-ELECTRIC Locomotive will start a heavier load and in switching service handle more ton-miles per day than any steam or gasoline locomotive of the same weight.

No loss of service by costly replacement and renewal of parts.

Capable of TWENTY-FOUR HOURS Continuous Daily Service

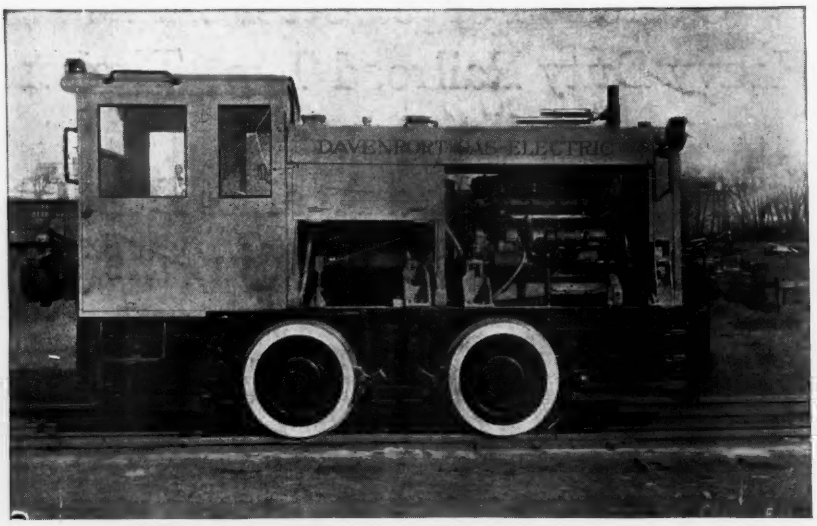
NO CLUTCH

NO TRANSMISSION

Special

New Water Muffler eliminates any discharge of sparks from Gas Engine.

Write Your Own Guarantee of What You Expect in an Industrial Locomotive



Simple in Design

A gasoline engine.
An electric generator.
A controller.
A motor for each axle.
All wheels are drivers.

Simple in Operation

One hand for control.
One hand for brakes.
Foot accelerator.
Any one can operate at once.

Built in 4, 6, 8, 10, 12, 16, 20, 24 ton sizes—for all track gauges.

Read what Mr. J. C. Little, formerly General Mechanical Engineer of the Chicago & Northwestern Railroad, says in his report to Mr. C. B. Moore, of the Oxweld Railroad Service Co., Chicago.

A Portable Electric Power Plant — for Electric Drills, Hoists, Windlass, any Electrical Apparatus, Cooking, and for Lighting the Camp.

The Oxweld Railroad Service Company
Railway Exchange
Chicago April 6th, 1927.

Mr. Charles B. Moore,
Office.

Dear Mr. Moore:

The demonstration at Davenport on April 5th, 1927, of the 10 ton Gas-Electric Locomotive, developed and built by the Davenport Locomotive Works, proved the practicability of a locomotive of this design for industrial switching. The locomotive successfully handled a load of approximately 100% above its normal rating showing there was a wonderful reserve power. Its use as an electric power plant was also demonstrated, showing that it could be utilized for furnishing current for many purposes. For instance, on construction work it could be used for lighting the camp, pumping water for camp use, running electric tools or, in fact, for any purpose within its limits where electric current was required.

The design has been carefully worked out, showing that high-class engineering skill has been used in the development of the locomotive. A well known make of gasoline engine is used and the General Electric Company's electrical equipment.

There is nothing new in the principles involved in adapting the gas-electric drive to a locomotive as this principle has been used for a number of years on railroad motor cars for branch line service and short hauls, and more recently, very successfully for motor bus service, power shovels and larger locomotives.

There is, without question, an extensive field for the small units, such as the Davenport Locomotive Works proposes building, from 8 tons to 24 tons, and they would have many advantages over steam and mechanically driven gasoline locomotives. The following are some of the advantages:

Uniform continuous torque at the wheel rims means less wear on the track.

Very little water is required and therefore expensive water stations would be eliminated as well as the troubles due to bad water conditions.

Coaling plants, ash pits, etc. would be eliminated.

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Because of its small mechanical parts the necessity of heavy shop machinery would be eliminated.

It provides higher tractive effort in starting and at slow speeds, on lighter axle loads.

Its operation is practically noiseless and smokeless.

The fire hazard is removed where a locomotive is used on logging roads, in lumber yards or similar places.

Its short, rigid wheel base makes possible its use on very short curves.

Its electric transmission protects the engine from the strains and shocks to which it would be subjected with a mechanical driving transmission between engine and driving wheels.

The electric transmission is equivalent to a gearing with an infinite number of gear changes and is self-shifting.

Costly delays, due to taking locomotive out of service for boiler washing and inspections, are eliminated.

There are no standby losses as engine could be shut down during idle time. Full power would be immediately available when required.

Its availability for service would be about double that of the steam locomotive.

The mechanical drive, such as is used on the gasoline locomotive, has been used for many years in various kinds of equipment and there has always been no end to clutch and transmission troubles. This, of course, means high maintenance cost and a reduction in time that the locomotive is available for service and would be unfavorable to this type of locomotive.

Taking everything into consideration there seems to be a very favorable outlook for the use of the gas-electric locomotive for industrial switching.

Yours very truly,
J. C. Little

JCL-WCF

Rear or Center Cab Construction, Semi-Elliptic Springs, Cross-equalizer — 3-point suspension, Self-Adjusting for all varying track conditions — All Wheels are Drivers.

We built this locomotive with POWER + PLUS to meet your requirements.

DAVENPORT LOCOMOTIVE WORKS **DAVENPORT, IOWA**